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FINAL ENVIRONMENTAL IMPACT STATEMENT

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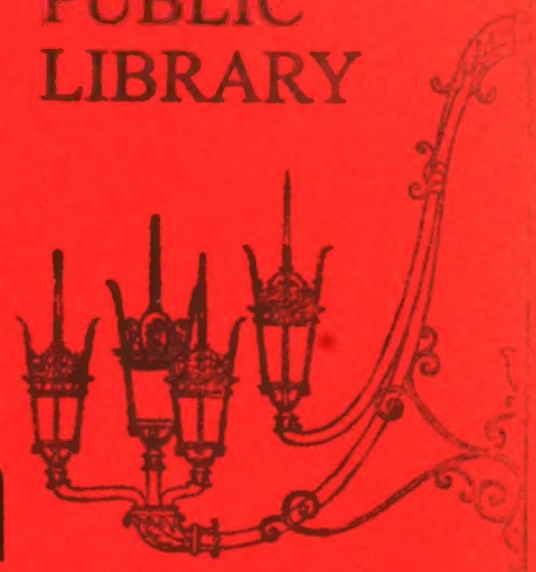

Red Line Extension Harvard Square to Arlington Heights Boston, Massachusetts

U.M.T.A. Project Number
MA-23-9008

August 1977

U.S. Department of Transportation
Urban Mass Transportation Administration

T23
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DEPARTMENT OF TRANSPORTATION
URBAN MASS TRANSPORTATION ADMINISTRATION
WASHINGTON, D.C. 20590

August 26, 1977

Re: Final EIS for Red Line Extension

Dear

The Massachusetts Bay Transportation Authority(MBTA) has submitted an application for Federal capital grant assistance under the Interstate substitution provision of the Federal-Aid Highway Program to the Urban Mass Transportation Administration(UMTA) for construction of an extension of the Red Line from Harvard Square to Arlington Heights, Massachusetts. The project involves the construction of a 6.4 mile extension, 5 new stations and the relocation of an existing station at Harvard Square. The requested Federal grant is approximately $500,243,200. The total cost of the project is $625,304,000.

Pursuant to applicable laws, the enclosed final environmental impact statement on the proposed project has been prepared. The UMTA review process has taken into account comments of various organizations and individuals on the draft EIS which was circulated starting in November, 1976. The draft was revised where necessary to address issues which were raised.

The final statement is being forward to appropriate agencies, as well as those who commented on the draft. UMTA will observe a 30-day period before reaching a final decision on the project application.

Sincerely,

Edward R. Fleischman

for Peter Benjamin
Director
Office of Program Analysis

Enclosure

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FINAL ENVIRONMENTAL IMPACT STATEMENT AND 4(f) STATEMENT

U.S. Department of Transportation
Urban Mass Transportation Administration

RED LINE EXTENSION - HARVARD SQUARE ARLINGTON HEIGHTS, BOSTON, MASSACHUSETTS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

UMTA PROJECT: MA-23-9008

This transportation improvement is proposed for funding under the Interstate substitution provision of the Federal-Aid Highway Program - Title 23 United States Code Section 103 (e)(4).

The statement is submitted pursuant to Section 102(2)(c) of the National Environmental Policy Act (NEPA) of 1969(PL91-190); Section 3(d) and 14 of the Urban Mass Transportation Act of 1964 as amended; Section 4(f) of the Department of Transportation Act of 1966; and Section 106 of the National Historic Preservation Act of 1966.

AUG 16 1977

DATE

By: _____
John K. Taylor
Acting Associate Administrator
for Transit Assistance

PREFACE

This Final Environmental Impact Statement and 4(f) Statement was prepared by the Urban Mass Transportation Administration in coordination with the Massachusetts Bay Transportation Authority and their consultants, DeLeuw, Cather and Company, and Sverdrup and Parcel and Associates. It represents documentation of the environmental impacts of the proposed Red Line rapid transit extension project in the Northwest subregion of the Boston Metropolitan area.

This statement is based upon the results of the Boston Transportation Planning Review Study. UMTA and the MBTA have been substantially involved in the preparation and development of this Final EIS and 4(f) Statement. The proposed project has been the subject of extensive discussion and review with public and local officials since 1974. Questions and comments raised at the three public hearings held on March 23, 24, and 25, 1976, and responses to them have been incorporated into this document. Many community meetings and workshops have been held to consider the proposed project and are fully discussed in Appendix F-Municipal Considerations. Most of the data in this document was taken from the Environmental Impact Assessment produced by the MBTA. Sections have been rewritten and expanded to include additional data and information, and portions have been revised or added as appropriate.

All new information added to this Environmental Impact Statement and 4(f) Statement since the November, 1976 DEIS is identified by two types of keys; a dot indicating new data in a line, and a vertical line in the margin indicating added text.

The Draft EIS and 4(f) Statement was circulated on November 29, 1976, to various Federal, State and local agencies, and to interested organizations and individuals in accordance with the guidelines set by the Council on Environmental Quality and United States Department of Transportation procedures.

The Final EIS and 4(f) Statement addresses all substantive comments which were made on the Draft EIS and includes all letters of comment submitted during the circulation.

The Final EIS and 4(f) Statement will be circulated to various Federal, State, and local agencies and to interested organizations and individuals.

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Summary Sheet

Final Environmental Impact Statement

Department of Transportation, Urban Mass Transportation Administration

1. Name of Action: Administrative Action

2. Description of Proposed Action:

   A. The Massachusetts Bay Transportation Authority (MBTA) has filed an application to UMTA for Federal capital grant assistance for a 6.5 mile extension of the Red Line rapid transit from its present terminus at Harvard Square to Arlington Heights. The Harvard Square Station will be rebuilt in a new location and 5 new stations will be constructed at Porter Square in Cambridge, Davis Square in Somerville, Alewife in Cambridge, and Arlington Center and Arlington Heights in Arlington. A parking garage for 2,000 vehicles is planned for Alewife and 350 at Arlington Heights. Approximately 1.5 miles will be in a tunnel/deep bore and approximately 5 miles will be tunnel/cut-and-cover. About 70% of this project will be constructed on existing railroad-owned right-of-way.

   B. The application requests assistance under the Interstate substitution provisions of the Federal-Aid Highway Act of 1973 and/or the Urban Mass Transportation Act of 1964, as amended. The total project cost is estimated at $625,304,000. The requested Federal share of the grant is $500,243,200.

   C. UMTA project number MA-23-9008.

3. Summary of Effects

   A. Long-term Beneficial Effects:

      1. Accessibility to the central business district will increase, particularly for the transit dependent. The elderly and handicapped will have improved mobility.

      2. This project would present an alternative to the automobile, which is compatible with the state-wide commitment to reduce auto-dependency. Transit usage will result in reduced travel time, reduced local traffic congestion, a more energy efficient system, and cleaner air.

      3. Through Freight Service will be transferred from Freight Cut-Off to New Hampshire Division Railroad.

B. Long-term Adverse Effects:

1. Freight rail service will be eliminated on the Lexington Branch of the MBTA Commuter Rail System from Alewife Outwards.

2. Fifteen (15) businesses will be displaced.

3. The project may cause increased growth pressures along the alignment and at stations. Coordinated land use planning efforts will control and direct these growth pressures.

C. Short-term Effects:

1. Construction easements are needed for 3.5 acres of publicly-owned parkland. This will cause minor interferences to recreational activities. A Section 4(f) statement is part of this document.

2. Approximately 3 acres of wetland vegetation will be disturbed during construction. Appropriate Federal and State permits will be procured.

3. Noise and localized air pollutant concentrations will increase during construction.

4. Temporary disruption of traffic and pedestrian patterns will occur.

5. There will be temporary construction impacts on two Historic Districts listed on the National Register and three sites of historical significance. The Section 106 process has been completed.

6. There will be a reduction in water quality due to sedimentation during the temporary relocation of Mill Brook and Alewife Brook, siltation downstream, run-off during construction in the Alewife Station area, and the temporary rerouting of the Little River. Mitigating techniques such as construction of retention/detention ponds, sediment basins and traps, grade stabilization structures, and the immediate seeding and mulching of slopes after construction to prevent erosion will be used.

7. Construction will generate employment opportunities.

D. Coordination with Massachusetts Department of Public Works

1. The Massachusetts Department of Public Works proposes to improve the roadways in the vicinity of the proposed MBTA Red Line Station at Alewife. Part of their proposal is a provision for direct ramp access to the Alewife Station and Parking Garage from Route 2.

2. During the preparation of this EIS, every effort has been made to coordinate both agency's proposals.

3. The proposed highway improvements at Alewife are discussed in an Environmental Overview Summary Update (EOSU) prepared by MDPW. A draft of the EOSU is included as Appendix J to the EIS. FHWA has not yet completed their review of this report, nor have they given final approval of the proposed improvements.

4. Alternatives Considered:

A. No-build Options:

1. Do-nothing

2. Priority rights-of-way for buses

B. Commuter Rail from North Station to Alewife

C. Extension of the Green Line from Lechmere to Alewife

D. Four Alternative Alignments for extending the Red Line between Harvard Square and Alewife.

E. Alternative terminal points

5. This Final Environmental Impact Statement is being circulated to the following agencies:

FEDERAL

. Assistant Secretary of Environment, Safety and Consumer Affairs, U.S. Department of Transportation

. Council on Environmental Quality

. Environmental Protection Agency, Regional Office

. Department of Housing and Urban Development, Regional Office

. Department of Interior

. Department of Health, Education, and Welfare

. Department of Agriculture

. Department of Commerce

. Advisory Council on Historic Preservation

. Federal Energy Administration

. Federal Highway Administration Division Office

. Federal Railroad Administration

STATE

. Department of Environmental Quality Engineering

. Office of State Planning (State A-95)

. Department of Public Works

. Massachusetts Commission Against Discrimination

. Department of Elderly Affairs

. Massachusetts Historical Commission (HSPO)

LOCAL

. Metropolitan Area Planning Council (Regional A-95)

. Ms. Gail P. Rotegard, MAPC Rep., Boston

. Mr. Philip Zeigler, Boston Redevelopment Authority

. Mr. Lowell Richard, III, Office of Program Development

. Mr. Alan McClennen, Jr., MAPC Rep., Arlington

. Mr. Richard A. Easler, MAPC Rep., Cambridge

. Mr. Frank A. Sestito, MAPC Rep., Somerville

. Mr. Albert P. Zabin, MAPC Rep., Lexington

. Mr. Richard Anderson, MAPC Rep., Bedford

. Mr. M. Perry Chapman, MAPC Rep., Belmont

and other appropriate agencies and offices.

6. The Draft Environmental Impact Statement was circulated beginning November 29, 1976. This Final Environmental Impact Statement is made available August, 1977.

Based on information included in this Environmental Impact Statement (EIS) and comments received, the Administrator of UMTA in formally approving the project will make the following review and findings required by the respective sections of the Urban Mass Transportation Act of 1964 as amended.

Section 3(d) revised . . . . that the application -

(1) has afforded an adequate opportunity for public hearings pursuant to adequate prior notice, and has held such hearings unless no one with a significant economic, social, or environmental interest in the matter requests a hearing;

(2) has considered the economic and social effects of the project and its impact on the environment; and

(3) has found that the project is consistent with official plans for the comprehensive development of the urban area.

Section 14(b) . . . . the project application includes a detailed statement on -

(1) the environmental impact of the proposed project,

(2) any adverse environmental effects which cannot be avoided should the proposal be implemented;

(3) alternatives to the proposed project; and

(4) any irreversible and irretrievable impact on the environment which may be involved in the proposed project should it be implemented

Section 14(c) . . . . that -

(1) adequate opportunity was afforded for the presentation of views by all parties with a significant economic, social, or environmental interest, and fair consideration has been given to the preservation and enhancement of the environment and to the interest of the community in which the project is located; and

(2) either no adverse environmental effect is likely to result from such project, or there exists no feasible and prudent alternative to such effect and all reasonable steps have been taken to minimize such effect.

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IMPACT SUMMARY

IMPACT SUMMARY

Impact Category	Overall Project Characteristics	For Details See: Table #	Page #
POLITICAL			
Regional	Compatibility with state-wide commitment to reduce auto travel and dependancy; function not only to link suburbs to CBD and Cambridge, but to serve local interests, reinforce neighborhood shopping patterns, provide social and cultural opportunities through increased mobility; to serve both peak and off-peak travel needs.	-	I-4 II-25 II-36 II-40 II-89
Municipal	Would reduce local traffic impacts, provide increased mobility for resident and business needs.	-	Appendix F
ENGINEERING			
Length	6.5 miles	II-1	-
Construction Cost	$614,602,000	II-4	-
Land Acquisition Cost	$8,432,000	II-4	-
Relocation Cost	$908,000	II-4	-
Retirement of UMTA Loan for purchase of B&M property	$1,362,000	II-4	-

IMPACT SUMMARY (cont'd)

Impact Category	Overall Project Characteristic	For Details See: Table #	Page #
TRAFFIC AND TRANSPORTATION			
Diversions from Auto to Transit	7,675 vehicle-trips/day	-	II-36
Traffic Volume and Congestion	Reduced overall corridor auto travel; congestion in station areas (10,040 daily auto arrivals)[1] particularly during peak-hour.	II-17	-
Travel Time Savings	1.15 million person-hours/year	II-7	II-29
Travel Cost Savings	$4.53 million/year	II-8	II-29
Daily Inbound Boardings	42,700[2]	II-13	II-45
Access for Handicapped	Provisions for elevators, ramps and other design features.	-	III-7, IV-3 V-2, VI-4 VII-4, VIII-5
Rail Freight Service			
Firms Requiring Relocation because of loss of service	3	-	II-59
Firms Able to Adopt team-track or other means	5	-	II-55 A
Commuter Rail Interface	Inter-modal change facility at Porter Square between the MBTA Commuter Rail and Red Line.	Fig. IV-3,4	II-61 IV-3

1 includes park-and-ride and kiss-and-ride
2 with limited parking supply

Impact Category	Overall Project Characteristics	For Details See: Table #	Page #
LAND USE	Potential development over ROW and vacant lands along alignment; more likely to experience increase in intensity of land uses rather than change. Residential and commercial activity likely to concentrate around station areas - no net increase anticipated, only redistribution. Control of type and quality/quantity of growth possible through public officials, local planning staff and joint development subcommittees established during design phase.	-	III-38 IV-20 V-25 VI-33 VII-26 VIII-28
COMMUNITY FACTORS			
Residential Displacement	None	-	-
Business Displacement	15 Businesses	-	IV-24, V-20 VI-42, VII-3 VIII-37
Tax Loss (1975 Revenues)	$61,915	II-34	-
PARKS, RECREATION AND HISTORIC RESOURCES			
4 (f) and 106 involvement	Temporary construction effects on two Historic Districts, listed on the National Register.	-	II-127 and Appendix G
	Approximately 0.60 acres of Russell Field in Cambridge would be disrupted during construction; would not affect the recreational facilities.	-	II-143

IMPACT SUMMARY (cont'd)

Impact Category	Overall Project Characteristics	For Details See: Table #	Page #
	A 0.2 acre Traffic Island, dedicated as Whittemore Historic Park in 1967, containing a statue commemorating a Revolutionary War Battle, will be disrupted during construction activities for the Arlington Center Station.	-	II-157
	A Kiosk serving as a head house for the existing MBTA Station entrance at Harvard Square would be dismantled and stored during construction and restored after construction.	-	II-138
	Turn of the century railroad bridge abutments would be displaced between Arlington Center and Arlington Heights because the project is aligned along the railroad ROW to reduce displacement and disruption to built-up areas of Arlington. The abutments were rated as "mentionable", the lowest category of local significance.	-	II-161
	Design details during subsequent phases will require coordination with the State Historic Preservation Officer to assure compatibility with historic districts listed on the National Register in Harvard Square and Arlington Center.	-	II-128
ENVIRONMENTAL OR NATURAL RESOURCES			
Vegetation/Wildlife Habitat Wetlands	Temporary disruption of between 1.2 to 3.2 acres; possible permanent alteration of this land to urban park use.	-	VI-103
Disturbed Urban Vegetation	Removal of 15,000 feet in linear ROW vegetation-varies in quality and quantity; possible replanting for linear park plan.	-	VIII-63

IMPACT SUMMARY (cont'd)

Impact Category	Overall Project Characteristics	For Details See: Table #	Page #
Hydrology and Water Quality	Runoff problems in Alewife Station area during construction, consequent temporary reduction in water quality; water storage capacity would be increased by retention/ detention pond construction.	-	VI-104
Noise and Vibration	Increased traffic could affect noise levels around stations. Possible rumble from vibration to buildings within 100 feet of tunnel; - special track work can reduce or eliminate impacts. Untreated shafts could generate 75-80 dBA to 50 feet and affect homes within 100-200 feet. Noise would decrease in areas presently affected by freight operation noise if freight services were eliminated.	-	II-118
Air Quality	The greatest improvement in air quality over the area as a whole would result from more effective control of CO emissions from automotive vehicles. However, while the 1-hour EPA standard for CO could be met by emission control measures alone, compliance with the 8-hour EPA standard by 1980 throughout all of Cambridge may be contingent upon construction of the Red Line Extension.	-	II-102
Energy	Based on the estimated auto diversions and consequential reduction in VMT, the 1980 energy savings associated with an extension to Arlington Heights would be above 2,444,400 gals. per year. This represents an estimated annual dollar savings of $1,466,666.	-	II-116

IMPACT SUMMARY (concluded)

Impact Category	Overall Project Characteristics	For Details See: Table #	Page #
CONSTRUCTION			
Employment	10,850 Man-years representing 2,700 Site Jobs	-	II-81
Payroll	$262.48 million	-	II-81
Hydrology and Water Quality	Possible siltation and filling; ponding, mulching, rip-rapping, etc. can reduce impacts; temporary rerouting of Mill Brook and Little River.	-	II-187
Noise and Vibration	Possible impacts from construction activity and vehicles; careful construction techniques and use of modern equipment with noise abatement devices would reduce impacts.	-	II-186 Appendix D
Air Quality	Increase of suspended particles and CO levels due to traffic interference and construction activities selection of construction techniques and control and monitoring of construction activities could minimize impacts.	-	II-185
Traffic	Disruptions would occur primarily in station areas--delay due to congestion, restricted access to some businesses; detours will route some traffic to local streets. Construction staging, temporary decking and other measures could reduce impact.	-	II-188

A SUMMARY OF ISSUES AND CONCERNS AND
COMMITMENTS OR MITIGATING MEASURES TO MINIMIZE HARM

PROJECT ALIGNMENT AND PROFILE

Issue or Concern	Commitment or Mitigating Measure	EIS Ref.
Underground versus at-grade or depressed in open-cut. Extent of takings, displacements and relocations. Alternative alignments and station locations. Deep bore tunneling versus cut-and-cover tunneling. Sequence of construction and construction techniques. Alternatives to the Project.	. Approximately 60-70% of the proposed Red Line extension will be built within existing railroad rights-of-way which have all been purchased recently by the Authority.	Table II-2
	. Takings and displacements will be minimized-no residential displacements would be required and only 15 businesses would be displaced.	Page S-3
	. The Project profile will be completely underground in either a tunnel/deep bore or a tunnel/cut-and-cover for the Project's entire 6.5 mile length. Stations and turnback and layup facilities will also be completely underground.	Table II-2

Issue or Concern	Commitment or Mitigating Measures	EIS Ref.
Temporary and permanent locations; ultimate extension to Route 128; phasing of segment construction. Potential impacts of temporary terminals at Alewife, Arlington Center and/or Arlington Heights. Requirements for terminal facilities. Findings of the Minuteman Area Transit Study.	. The first section of the Project to be constructed, Harvard Square to Alewife, will not be opened until construction has begun on the Alewife to Arlington Heights section, assuring that Alewife would not become a permanent terminal.	Table II-3, Page II-18
	. The Arlington section, Alewife to Arlington Heights, will be built as one section to assure that Arlington Center will not become either a temporary or permanent terminal.	Table II-3 Page II-18
	. Arlington Heights will be a temporary terminal until the proposed Extension to Route 128 is completed.	

VEHICLE/PEDESTRIAN CIRCULATION

Issue or Concern	Commitment or Mitigating Measures	EIS Ref.
Traffic impacts on local streets around station areas, particularily around Alewife, Arlington Center, and Arlington Heights; impacts on local parking supplies.	. The City of Cambridge has retained a Traffic Consultant to study potential traffic impacts that would be associated with transit station construction and new development occuring around transit stations.	Appendix K
Effect of proposed station designs on pedestrian and bicycle movement and vehicular access to stations. Effects of construction activities on pedestrian and vehicular flows.	. The Pre-grant Engineering contracts for the Arlington section of the project will have provisions for further study and analysis of station related traffic impacts in the Arlington Center and Arlington Heights areas. The findings and recommendations of these studies would be used to guide final planning and design of station access and circulation systems.	VIII-1
Pedestrian movement within stations and parking garages.	. Station designs will incorporate free access passageways under major streets.	IV-3, VII-3
Access to homes and businesses during construction activities.	. Traffic circulation, street and intersection closures, and parking accommodations in station areas will be designed to limit intrusions to adjacent neighborhoods.	II-188
	. Streets, roadways, bikeways and pedestrianways adjacent to proposed stations will be improved to increase access to station facilities, reduce traffic congestion, and minimize vehicular/pedestrian conflicts.	VI-5

Issue or Concern	Commitment or Mitigating Measure	EIS Ref.
	. Construction will be phased to minimize disruption to pedestrian and vehicular circulation. Phased decking procedures will be used to permit near-normal traffic operations.	III-34, III-52 IV-6, IV-26, V-6, V-21, 22, 23
	. Temporary or detour routes will be established to maintain existing levels of service on bus and trackless trolley lines.	III-33, III-35
	. Scheduling of construction activities will be coordinated with contractors, local police, fire and utility departments, affected retailers and businesses, and other concerned agencies and organizations.	II-188
	. All access, including service truck access, to residences and businesses will be maintained during and after construction of the Project.	II-189

PARKING FACILITIES

Issue or Concern	Commitment or Mitigating Measures	EIS Ref.
Location and magnitude of parking facilities required by Project. Impacts of garage generated traffic at Alewife and Arlington Heights. Secondary impacts of highway improvements proposed for and around station areas.	. The Authority will work with the Massachusetts Department of Public Works, the City of Cambridge, and the Alewife Task Force to develop road improvements at Alewife which will provide optimum access to the Alewife Garage while minimizing impacts to local streets in terms of traffic congestion and other auto-generated impacts.	Volume III Appendices J and K
	. The proposal for a parking garage at Arlington Center has been abandoned in response to community opposition to this facility. However, the Authority, in cooperation with the Town of Arlington, will continue to investigate other alternatives for parking facilities in the Center which would be more in line with the parking objectives of the Town.	VI-1, VI-4 Appendix F
	. The Arlington Heights Garage will be planned and designed as a local facility to serve primarily Arlington and East Lexington patrons. Pre-grant Engineering for the Arlington Heights and Arlington Center facilities will include provisions for further study of traffic impacts of proposed parking/drop-off facilities.	Appendix F Page VIII-1

Issue or Concern	Commitment or Mitigating Measures	EIS Ref.
Affects of Project on regional air quality. Affects of station generated vehicular traffic on local air quality. Degradation of air quality resulting from dust associated with construction activities.	. The Alewife and Arlington Heights garages will be designed to minimize congestion and reduce idle time of vehicular traffic both inside and outside of the structures.	VI-6
	. The Red Line Extension will result in improved air quality due to a more efficient use of energy and a reduction in automobile travel.	XI-2
	. Contract specifications will require the contractors to comply with all local, State and Federal air pollution control laws, codes and regulations.	II-185, II-103 X-2
	. Traffic during construction will be routed in ways to ensure that congestion and other disruptions are minimized.	X-2
	. All roadways from which construction activity might result in airbourne particulate matter will be wetted on a regular basis.	V-27, X-2, VII-8
	. Covers will be placed over aggregate piles from which materials might be blown. In transit, such materials will be transported in covered containers.	X-2

Issue or Concern	Commitment or Mitigating Measure	EIS Ref.
Energy efficiency of proposed system; reduction in vehicle miles traveled (VMT). Automobile disincentives and incentives for car pooling to MBTA parking garages. Energy efficient station and parking garage designs.	. The amount of fuel saved because of automobile diversions and a resulting decrease in vehicle miles traveled is more than the amount of fuel required to operate the Red Line Extension, including all ancillary facilities.	II-116
	. In terms of energy efficiency measured in passenger miles per gallon (PMPG), the Red Line Extension would initially be 3 to 4 times more efficient than automobiles used for commuting. This ratio would increase to 7 to 10 times more efficient as ridership increases and fuel becomes more scares in the 1980's and 1990's.	II-115

Issue or Commitment	Commitment or Mitigating Measures	EIS Ref.
Affects of transit development on land values, pressures for development and changes in land use. Secondary impacts of new development. Affects on zoning and land use policies. Visual impact of station and garage designs on surrounding neighborhoods.	. The Authority will continue to give support to Arlington, Cambridge and Somerville to study land use related issues and concerns in the immediate area of the proposed stations. The Joint Development Program will be implemented in all three communities.	IV-27, V-27 VI-61
	. Station designs will be developed through a coordinated review process with local groups and agency officials. Design of all transit improvements will be of the highest quality.	III-5, IV-2, V-2, VI-3, VII-3, VIII-4
	. Improvements at the station areas will include provisions for extensive landscaping, appropriate street furniture and fixtures, and other amenities which will improve the over-all quality of the urban environment.	III-5, IV-2, V-2, VI-3, VII-3, VIII-4

ECOLOGY/WILDLIFE

Issue or Concern	Commitment or Mitigating Measures	EIS Ref.
Possible effects of Project on Alewife Brook and Mill Brook natural environments. Disruption of ecologically sensitive areas during construction. Affects of construction activities on wildlife.	. Measures will be taken during construction activities to protect wildlife and ecological resources.	VI-97 thru VI-109
	. Use or disruption of ecologically sensitive lands will be minimized during the construction phase by confining operations to the right-of-way as much as possible.	VI-97 thru VI-109
	. After completion of construction, all surface areas disrupted by construction activities will be restored to their natural state.	VI-97 thru VI-109

Issue or Concern	Commitment or Mitigating Measure	EIS Ref.
Potential disruptions to utility service during construction.	. All utilities will be relocated and maintained during construction. Plans will be coordinated with utility companies and subsequent construction procedures will be developed which are acceptable to the utility companies.	II-191 VI-10 VII-8

PUBLIC SAFETY/SECURITY/USER CONVENIENCE

Issue or Concern	Commitment or Mitigating Measure	EIS Ref.
Safe and convenient access to stations for all user groups. Security and safety during construction activities. Convenient station exit/entrances.	. Ticket booths will be located to permit maximum surveillance of public areas to optimize personal security.	V-2, V-32, VII-5, VII-50 VIII-49
	. Bus loading/unloading areas will be designed to ensure safe boarding during all hours of operation.	V-32
	. Removal of the Freight Cutoff and Lexington Branch will eliminate several existing pedestrian/rail and vehicular/ rail conflicts in Cambridge, Somerville and Arlington.	V-33
	. MBTA Police will patrol the new extension and will have direct communication with station attendants.	VII-50
	. Sight lines for vehicular travel will be improved with the removal of the Lexington Branch Railroad embankment in Arlington.	VII-50
	. Construction areas would be fenced off. If necessary, security guards will be provided to monitor sites during off-hours.	VII-8
	. Major considerations will be given to maintenance of pedestrian and vehicular traffic during construction.	VII-8
	. To avoid impacting of residential areas with truck traffic, materials will be transported linearly in the right-of-way where possible.	VI-10, VII-9, VIII-7

Issue or Concern	Commitment or Mitigating Measures	EIS Ref.
Impacts of Project on land values, rents, and taxes. Service to young, elderly and handicapped, and other disadvantaged groups. Construction employment and economic impact, especially for minority groups.	. All property takings and business relocation will be in compliance with the Federal Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 and Chapter 79A of the General Laws of Massachusetts.	IV-29, V-25 II-22
	. All businesses that are required to be relocated will receive relocation payments and compensation for any economic injury.	IV-29, V-25
	. All facilities on the Red Line Extension will be made 100 percent accessible to the elderly and handicapped.	IV-3, V-2, VII-4, VIII-5
	. Construction activities will be phased to have the least impact on business and shopping activities. Access to all businesses will be maintained. Protective measures will be taken to ensure safety and security of business operations adjacent to construction activities.	IV-26
	. Construction activities will be phased and carried out in a manner to minimize temporary disruptions and/or use of commercial parking spaces. If possible, temporary parking facilities for business patrons will be provided at other locations.	IV-19
	. Minority employment and the use of minority vendors will be maximized during the construciton period.	

Issue or Concern	Commitment or Mitigating Measure	EIS Ref.
Cost to State, impact on MBTA deficit; impact on local assessment. Parking and rider fares.	. Project construction costs are high, but the benefits of the Project in terms of energy saved, increased employment opportunities, and expanded service for the disadvantaged and young will outweigh this initial capital investment.	S-1 thru S-6
	. Operating revenues for the proposed extension are projected to be about 66 percent of operating costs. This means the proposed extension would be about twice as efficient as the existing rapid transit system for which only about 33 percent of operating costs are met by operating revenues.	IX-24, IX-35
	. Local MBTA assessment to Arlington, Cambridge and Somerville are projected to change only slightly as a result of the Red Line Extension and proposed changes to bus routing.	II-52a

FEEDER BUS SERVICE

Issue or Concern	Commitment or Mitigating Measure	EIS Ref.
Level of service, impacts on local assessment. Feeder bus service during construction design at bus unloading/loading facilities at proposed stations.	. The feeder bus system proposed in conjunction with the Red Line Extension will provide service equal to or exceeding present levels of service. No routes will be abandoned. Final acceptance of the proposed system will be contingent on approval by local communities.	II-50 thru II-53

USE OF RIGHT-OF-WAY ABOVE SUBWAY TUNNEL

Issue or Concern	Commitment or Mitigating Measure	EIS Ref.
Potential for Joint Development or development of a linear park/open space link.	. The Authority is committed to a program of cooperative planning and development of the open space areas above the subway tunnel within the old railroad rights-of-way. Provisions for preliminary planning and design of these areas will be part of the Pre-grant Engineering contracts for the Davis Square to Alewife segment. Similar studies will be conducted for the Arlington portion of the Project at which time the Authority will work with Arlington to develop their linear park concept.	VII-2, VII-35 VIII-3 VIII-6 VIII-31

COMMUTER RAIL/FREIGHT SERVICE

Issue or Concern	Commitments or Mitigating Measures	EIS Ref.
Inter-modal connections with commuter rail service. Future of freight service on Lexington Branch and Fitchburg Freight cutoff. Improvements to Porter Square Commuter Rail Station.	. Transfer to the commuter rail service will be possible at the Porter Square Station.	IV-2
	. Team track facilities will be constructed to service businesses who will loose rail access abandonment of Freight Service on the Lexington Branch and the freight cutoff between Alewife and Davis Square.	VI-2

PARKS/OPEN SPACE/RECREATION

Issue or Concern	Commitment or Mitigating Measures	EIS Ref.
Potential disruptions to parks/ open space, recreation areas during construction and once Project is in operation. Impacts to 4(f) lands. Development of new recreational opportunities in conjunction with transit project. Accessibility to facilities.	. During the Pre-grant Engineering phases, the Authority will assist in the development of open space plans for the re-use of the abandoned railroad rights-of-way over the subway tunnel.	VII-38
	. After completion of the tunnel/cut-and-cover from Davis Square to Arlington Heights, the Authority will improve the right-of-way through a program of landscaping and seeding.	VII-38
	. Protective measures will be implemented during the construction phase to minimize impacts to parks, open space, and recreation areas or the use of these facilities. The Authority will comply with all provisions of Section 4(f) of the DOT Act of 1966.	See Section 4(f) Analysis, II-127
	. Construction activities will be phased to cause the least disruption to facility use and access to facilities.	4(f) Analysis, II-127 thru II-180
	. Portions of facilities disrupted for construction purposes will be restored to their original condition after completion of construction operations.	4(f) Analysis,
	. Displaced vegetation will be replaced with identical or similar vegetation upon completion of construction.	4(f) Analysis, II-127 thru II-180
	. Access to facilities will be maintained at present levels during the construction period.	4(f) Analysis, II-127 thru II-180

Issue or Concern	Commitment or Mitigating Measure	EIS Ref.
Impacts of construction activities on historic and/or archaeological resources, especially to Section 106 properties at Harvard Square and Arlington Center. Impacts of station designs on character of historic districts. Potential for archaeological finds.	. Control and protective measures will be taken to negate any potential noise and vibration impacts which may affect historic resources.	II-132
	. Final design of all above ground station elements at Harvard Square and Arlington Center will be compatible with the historic character of these areas. All design proposals will be reviewed with local Historic Commissions.	II-133, II-165
	. An archaeological investigation will be conducted prior to any construction activities to ascertain the existence of any archaeological resources.	II-129
	. All historic structures will be closely monitored during construction activities and will be examined periodically following completion of construction.	IV-44, V-36
	. Ongoing coordination with the Cambridge and Arlington Historical Commissions will be maintained throughout the construction process to assure an absolute minimum of disruption.	IV-44, II-161, II-141-142
	. All historic resources that may be impacted as a result of construction activities will be protected from such activities.	See Section 4(f) Statement and Section 106 Case Report

Issue or Concern	Commitment or Mitigating Measure	EIS Ref.
	. All historic resources temporarily disrupted during construction will be returned to their original condition after construction is completed. The reuse or relocation of certain historic structures will be as prescribed by the appropriate Historic Commission.	III-61 II-139 II-158 II-159 II-161
	. An archaeologist will perform a reconnaissance study of the project alignment before construction begins. An archaeologist will also be available in accordance with Massachusetts law throughout the construction process to make site investigations.	II-129
	. The Authority will keep the Massachusetts and local Historic Commissions informed throughout the design development phase of all designs which may affect historic resources.	II-134 II-139

Issue or Concern	Commitment or Mitigating Measures	EIS Ref.
Affects on flooding and groundwater conditions along Alewife and Mill Brooks.	. Reduction in flood water storage capacity will be fully offset by retention/detention ponds to be constructed as part of the Project.	VI-102
Potential runoff, erosion, and siltation problems during construction.	. Site stormwater runoff will be equal to or less than existing runoff.	VI-100
Methods proposed to construct tunnel beneath Alewife Brook.	. Effects of project on water quality will be controlled in strict compliance with all State and Federal water quality regulations.	VII-65
Potential impacts to local drinking water sources or aquifers. Design of storm water retention/detention facilities.	. Catch basins at garages and stations will be equipped with traps to capture heavy sediments, large objects, and spillage during dry periods.	VI-102 VI-103
Disposal of excavated materials.	. Oil-grit separators will be incorporated into garage design to control pollutants.	VIII-65
	. Further consideration of water quality/hydrology issues and concerns will be part of the Mystic River Watershed Hydrology Study which is sponsored in part by the Authority. The findings and recommendations of this study would be considered during the final planning and design phases of the tunnel and stations at Alewife and along Spy Pond and Mill Brook in Arlington.	II-96

Issue or Concern	Commitment or Mitigating Measures	EIS Ref.
	. The MBTA will require all Contractors to follow the provisions of the Massachusetts Department of Public Works Standard Specifications, Section 7.02, entitled "Prevention of Water Pollution-Sanitary Provisions."	II-187
	. Project Specifications will require Contractors to prohibit deposition of excavated materials in or near streams or lakes where entry into the water is probable.	II-187 II-188 VII-65
	. Pumping of storm water during severe storms will be controlled so the municipal sewer capacities are not exceeded.	II-191
	. A permit from the Army Corps of Engineers and approvals from the Department of Environmental Quality Engineering will be obtained for all hydraulic work on Mill Brook Little River and Alewife Brook undertaken as part of the Project.	VIII-64 VI-104
	. Provisions will be made to protect and maintain groundwater levels at present levels during construction and preclude permanent changes in the groundwater flow pattern.	VI-108

NOISE AND VIBRATION

Issue or Concern	Commitment or Mitigating Measures	EIS Ref.
Impacts to homes and businesses within zone of influence; particularly to sensitivity structures such as historical buildings and housing for the elderly.	. Special techniques to reduce noise and vibration such as continuous welded rail, floating slab track beds and resilent rail fasteners will be used.	II-119 thru II-122, IV-45, VIII-66
	. Ventilation and emergency shafts will be designed to reduce noise from passing trains which would otherwise reach the community.	IV-46, V-38, VI-110
Construct related noise and vibration impacts to homes and business. Machinery and truck noise.	. Special vibration control trackwork will be provided for all locations where residences are within 100 feet of the proposed alignment.	II-119, V-37, VI-111,VII-67 VIII-66
	. During the Pre-grant Engineering phases, noise consultants have been or will be on hand at public information meetings to discuss noise and vibration reduction techniques.	
	. Noise and vibration will be considered during planning and staging of construction to ensure quiet operations.	II-186
	. Contractors will be required to comply with guidelines for construction noise abatement and reduction.	Appendix D VII-8
	. Maintenance on construction equipment and on machinery noise abatement devices will be required.	V-27

NOISE AND VIBRATION (Cont.)

Issue or Concern	Commitment or Mitigating Measures	EIS Ref.
	. Use of existing railroad rights-of-way for most of the Project alignment will greatly reduce the number of homes and businesses which potentially could be impacted (only about 40 homes are within the zone of influence).	

Chapter I

INTRODUCTION : BACKGROUND

Chapter I

INTRODUCTION: BACKGROUND

METROPOLITAN GROWTH AND TRANSPORTATION NEEDS

The Red Line rapid transit subway, opened in 1912, links downtown Boston with a terminal station at Harvard Square in Cambridge. Since then the population of the Boston Metropolitan Area increased by more than one million persons. Population in the Northwest Subregion, defined below, increased by approximately 55,000 between 1960 and 1970 without a corresponding expansion in transit facilities. The type and distribution of urban land uses has also changed dramatically. Changes in the number and location of homes, jobs, shopping and recreational opportunities have also created a growing need for improved transportation in the Northwest Subregion.

In response to this need and as a part of the cooperative, comprehensive and continuing (3-C) planning process, the Unified Work Program (UWP) and Transit Development Program for the Boston Metropolitan Area requested this technical study entitled, "Environmental Analysis for Red Line Extension - Harvard Square to Arlington Heights". It was initiated by the Massachusetts Bay Transportation Authority (MBTA) in December 1974, with the assistance of an Urban Mass Transportation Administration grant. All procedures and contracts are consistent with Federal regulations as well as those of the MBTA and the Commonwealth of Massachusetts.

Definition of Transportation Study Areas

A Red Line Extension has long been considered to shape and serve growth in what has been defined in previous studies as the Northwest Subregion. This and other areas of transportation analysis are defined as follows:

- Metropolitan Boston: defined in the Boston Transportation Planning Review (BTPR) as the area enclosed by the circumferential highway, Route 128.

- Northwest Subregion: (synonymous with Northwest Corridor) an area containing 20 communities in the Northwest quadrant of the Metropolitan Area.

- Urbanized Area: defined by the BTPR as the composite of the following areas.

  a. Urban Core: that part of the Urbanized Area within a 5.5 mile radius of the State House.

  b. Outer Ring: that part of the Urbanized Area between the 5.5 mile radius and an 11 mile radius which approximates Route 128.

CHRONOLOGY OF MAJOR STUDIES AND POLICY STATEMENTS

Extension of the Red Line beyond its present terminus at Harvard Square has been studied for over 30 years. According to local sources in Cambridge, three routes were proposed for examination by a Planning Board report in 1945. These routes may have been an outgrowth of a report prepared in April 1945 by the Metropolitan Transit Recess Commission which proposed extensions of rapid transit service into suburban Boston. A line was suggested along the Charles River from Harvard Square to East Watertown and then north to Alewife Brook and Arlington Heights.

Extending the Red Line to Alewife Brook has also been under consideration, and for a shorter period of time, the MBTA has also considered an extension beyond Alewife Brook along the MBTA Commuter Line, formerly the Boston and Maine's Lexington Branch, through Arlington and Lexington, and terminating near Route 128 at the Lexington-Bedford town line. A 1956 location study was conducted on a route from Harvard Square to the Arlington-Lexington town line. Later studies limited the extension to Alewife Brook parkway. In 1966, the MBTA prepared a report entitled "Program for Mass Transportation" which outlined a preliminary program for the Boston Metropolitan Area. Extension of the Red Line to Alewife Brook Parkway was proposed, with railroad service on the Fitchburg and Lexington lines operating from that terminal.

In March 1967, the MBTA released a report entitled "Interim Report on Harvard Square Site Studies". This study presented four schemes (indicated as Lines A, B, C and D) for improving or relocating both the Harvard Square Station and the tunnel alignment and grade from the station to a point on Massachusetts Avenue near Everett and Chauncy Streets. At this point, the four lines would merge into one alignment to the Porter Square Station.

A route was developed in a 1968 "Preliminary Engineering Report" that generally consisted of cut-and-cover tunnel construction from Harvard Square along Massachusetts Avenue to Porter Square; at-grade construction along the former Boston and Maine's Fitchburg right-of-way between Porter Square and Alewife Brook Parkway; and a terminal at Alewife. A group of West Cambridge residents vigorously opposed this plan, particularly that portion along the railroad right-of-way. Objections were raised regarding the potential disruption to businesses and traffic along Massachusetts Avenue resulting from the cut-and-cover construction. The report also included preliminary design for a relocated Harvard Square Station and a 33-acre terminal at Alewife with a 1,900-car parking lot and transit car storage area. The proposed relocation of the Harvard Square Station also met opposition. Subsequently, further plans for the extension were temporarily stalled until a Cooperation Agreement between the City of Cambridge and the MBTA was signed in October 1970. The agreement essentially limited planning along any part of a proposed alignment by one party without the consent of the other. A similar agreement between the City of Somerville and the MBTA was signed in September 1972.

During this time, a number of other studies were conducted. The Eastern Massachusetts Regional Planning Project in its 1968 "Recommended Highway and Transit Plan" proposed that the Red Line be extended from the Alewife terminal to Route 128 in Lexington via Arlington Center by 1990. Commuter railroad service would be maintained until adequate rapid transit service could be provided.

In 1969, at the request of the General Court, the MBTA prepared a report entitled, "Alternative Programs for Suburban Commuter Service". The report contained three alternative plans for consideration by the MBTA Advisory Board and the legislature.

Plan A proposed to continue existing railroad service on the Fitchburg, New Hampshire and Woburn routes and terminate service on the Lexington line. The Red Line would be extended to Alewife Brook Parkway.

Plan B proposed to discontinue railroad service and institute express bus service between Route 128 and a Red Line terminal at Alewife Brook Parkway. Busways would be constructed on the Fitchburg and Lexington rights-of-way.

Plan C would maintain commuter railroad service to those areas between North Station and the new terminals at Route 128 in Waltham and Woburn on the Fitchburg and New Hampshire routes, respectively. The remaining railroad service would be replaced by express bus operation on the Lexington Branch between Route 128 and a Red Line terminal at Alewife Brook Parkway.

None of the plans were acceptable to the MBTA Advisory Board primarily because no agreement could be reached on the need for the proposed improvements or on the means for financing these improvements.

In October 1970, the Cambridge City Council passed a resolution urging the MBTA to give high priority to the Harvard-Alewife transit extension, locating the line in tunnel/deep bore throughout its length. The MBTA was also requested to consider a Garden Street alignment. In the same year, the Governor called a moratorium on planning and construction of several highways within the Boston Metropolitan Area including Route 2 and the Inner Belt in Cambridge. The Governor then created the Boston Transportation Planning Review (BTPR) to evaluate several highway and transit alternatives, and the MBTA initiated new tunneling studies for the Red Line Extension.

Electrification of the commuter railroad lines over the next 20 years was considered in a 1972 report, "Plan for Acquisition and Use of Railroad Rights-of-Way" prepared by T. K. Dyer for the MBTA. It was proposed that Red Line rolling stock be equipped with pantographs for overhead power pickup for use on the Fitchburg and Lexington lines, with access to downtown Boston via a Red Line tunnel extension from Harvard Square to Alewife Brook Parkway. Green Line equipment would be used via Lechmere on the New Hampshire line and between Lechmere and Alewife Brook Parkway on the Fitchburg line.

A 1972 EOTC-MBTA report, "Commuter Railroad Improvement Program" proposed the preservation and gradual upgrading of existing railroad service with emphasis on short-term improvements.

The MBTA's April 1973 "Preliminary Tunneling Studies Report" examined the feasibility of shield-driven tunneling on selected alternative routes, and evaluated the type or types of construction appropriate for each alternative. The BTPR included information developed for this tunneling study in its "Preliminary Environmental Analysis", "Draft Environmental Impact Statement", "Preliminary Location Report" and "Program Package Evaluation Report", January 1973.

In April 1974, the City of Cambridge requested that the MBTA study alternatives A-(I), D and G in Harvard Square as general alignments with considerable latitude in the location of station platforms, access, bus tunnels and related issues. The request was based on (1) a report prepared by the Cambridge Planning and Development Department titled "How to Get Out of Harvard Square in a Train", dated February 1974, (2) review and recommendations on the content of the report by the Cambridge City Manager's Harvard Square Development Task Force, the Cambridge Transportation Forum, the Transportation Committee of the Cambridge Chamber of Commerce and the Department of Traffic and Parking and (3) comments from individual citizens.

In October 1976, the Arlington Board of Selectmen, in an official policy statement, moved "...that the official position of the Board of Selectmen is that we oppose the extension of the Red Line until those responsible for mass transportation produce the necessary plans and funding to accomplish our goals, namely, that of an underground configuration, throughout the Town; that there will be no terminus in Arlington, temporary or permanent, and that it will ultimately extend to Route 128; further that although we will cooperate in any way to assist in developing the information, citizen input and plans to accomplish these and related goals and objectives, we rescind our support until the total package has been produced acceptable to the citizenry of this community. Said action is not to be construed as lack of support for the concept of mass transportation through the development of the Red Line."

On April 13, 1977 a resolution was adopted at the Annual Town Meeting which stated that the Town will not support a proposal of the MBTA to construct an extension of the Red Line in Arlington until such time that prior to such construction it shall develop a satisfactory proposal which conforms to the wishes of the People of Arlington; that the extension be completely of a underground and covered configuration; that it be completely through the Town of Arlington with no temporary or permanent terminus; and that construction be done in one single phase.

The Boston Transportation Planning Review

The Boston Transportation Planning Review (BTPR) Study was initiated in 1970. Conducted with extensive community involvement, the study covered a comprehensive range of transportation alternatives. The "Northwest Preliminary Environmental Analysis", "Draft Environmental Impact Statement", "Preliminary Location Report", and "Program Package Evaluation Report" were prepared in 1973 and are referred to as the BTPR Red Book. Its function was to identify, evaluate and refine alternatives for the Northwest Subregion. A summary of this analysis and the subsequent narrowing of alternatives is covered in Chapter IX. of this report.

COMMUNITY LIAISON

The Community Liaison Program was a major effort in conducting the environmental analysis of the Red Line Extension from Harvard Square to Arlington Heights. Throughout the planning process, Federal and State laws require the participation of citizens for public projects which will affect their lives. The Consultant, with the assistance of the MBTA, the Central Transportation Planning Staff and the Metropolitan Area Planning Council; the cities of Cambridge and Somerville; and the Town of Arlington, established citizen participation programs which fully involved the public in the planning processes. Advice was solicited by the Consultant and consensus reached on such items as transit alignment, station location and design, parking, access, environmental impacts, and land use development. Major elements of the community liaison program included:

Station Area Transportation Advisory Groups and Task Forces

For each proposed station, a Transportation Advisory Group (TAG) or Task Force was established to advise the responsible governing bodies and agencies and provide input to the planning process concerning station development and related alternatives. The TAG's or Task Forces, which were established with the assistance of the MBTA and the local municipal governments, were responsible for presenting the public's viewpoint for each of the station areas. For the Porter Square, Davis Square, Arlington Center and Arlington Heights stations the MBTA asked the local governments to appoint a TAG to work with the Study Team. Studies of the Harvard Square area, which began earlier than the remainder of the stations, were coordinated with various groups listed in the Appendix. The makeup of the Transportation Advisory Groups consisted of representatives from local citizens groups; businessmen and business organizations; and the municipal governments. This cross section of interests and viewpoints contributed to a consensus on the issues affecting the needs of the entire community.

Because of the regional nature of the Alewife Area, the MAPC, assisted by the MBTA, the Massachusetts Department of Public Works, and the City of Cambridge, organized the Alewife Task Force and appointed Lawrence Susskind, Professor of Urban Studies and Planning at M.I.T., as Chairman. Representatives of State and regional agencies; the cities and towns of Cambridge, Somerville, Arlington and Belmont; and private interest groups and businesses were invited to participate. The MAPC letter of invitation as well as a list of the communities and organizations represented on the Alewife Task Force are included in the Supplemental Data Volume.

Concurrently with the Red Line Extension project, the Massachusetts Department of Public Works conducted an environmental impact study in connection with the Route 2 Highway Improvement project. The Alewife Task Force, in addition to rapid transit issues, addressed the problems inherent in this project.

The TAG's for the Porter Square, Davis Square and Arlington stations met every three to four weeks from January to June of 1975. The Alewife Task Force, due to its later start and the complexity of the issues, met every two weeks during March and April; weekly in May and June; and every two weeks from July to December, 1975.

Summary notes covering each TAG and Task Force meeting were prepared by the Study Team for distribution to the members prior to the following meeting. These summaries identified the important issues and questions raised during the meetings, and were used in establishing the agenda for subsequent meetings as well as to pinpoint the concerns the Consultant should examine. The mailing lists of the five groups totaled over 350 persons.

Red Line Working Committee

The Red Line Working Committee (RLWC), under the auspices of the Central Transportation Planning Staff, was responsible for considering and coordinating corridor-wide issues. Its members included representatives from State and regional agencies in addition to business and citizen groups from Cambridge, Somerville, Belmont, Arlington, Lexington, and Bedford. At the monthly meetings of the RLWC, the Study Team reported on the

progress in each station area and summaries of the TAG and Task Force meetings were distributed. The Consultant also kept minutes of these meetings and distributed them by mail to approximately 85 persons on the RLWC mailing list.

Presentations and Informational Talks

Other important aspects of the community liaison program included presentations and informational talks to civic organizations and business groups. These meetings served to inform the members of the community, who were not active participants in the community liaison effort, of the Consultant's activities and progress. They were arranged through invitations from the various organizations or at the suggestion of the Consultant so that the broadest possible coverage of the community could be maintained. These presentations also generated interest in the project and drew additional people into the TAG and Task Force meetings. The Chambers of Commerce in Cambridge, Somerville, and Arlington; businessmen's associations in Porter and Davis Square; and neighborhood organizations such as the Ward Six Civic Association in Somerville, the North Cambridge Planning Team and the East Arlington Neighborhood Association are examples of the groups that were involved. A list of regional and muncipal agencies, business and citizens groups, and businesses that were contacted during the study is contained in Appendix F.

Corridor Libraries

To provide easy access to project information and facilitate maximum participation by the public, project libraries were established in each Red Line corridor community. The Central Library in Cambridge, the West Branch of the Somerville Library, and Robbins Library in Arlington Center were designated as corridor libraries.

With the assistance of George Sanborn, MBTA librarian, each library was stocked with the following reference material relative to the present and previous Red Line studies:

> NORTHWEST - Boston Transportation Planning Review, consisting of Preliminary Environmental Analysis, Draft Environmental Impact Statement, Preliminary Location Report, Program Package Evaluation Report. (BTPR Red Book)

BTPR Red Book Summary

Plan for Acquisition and Use of Railroad Rights-of-Way, December 1972, Thomas K. Dyer, Inc.

Preliminary Engineering Report-Rapid Transit Extension, Harvard Square-Alewife Brook, February 1968, Sverdrup & Parcel and Associates.

Preliminary Tunneling Studies Report for Red Line Extension, Cambridge-Somerville, April 1973, Sverdrup & Parcel and Associates.

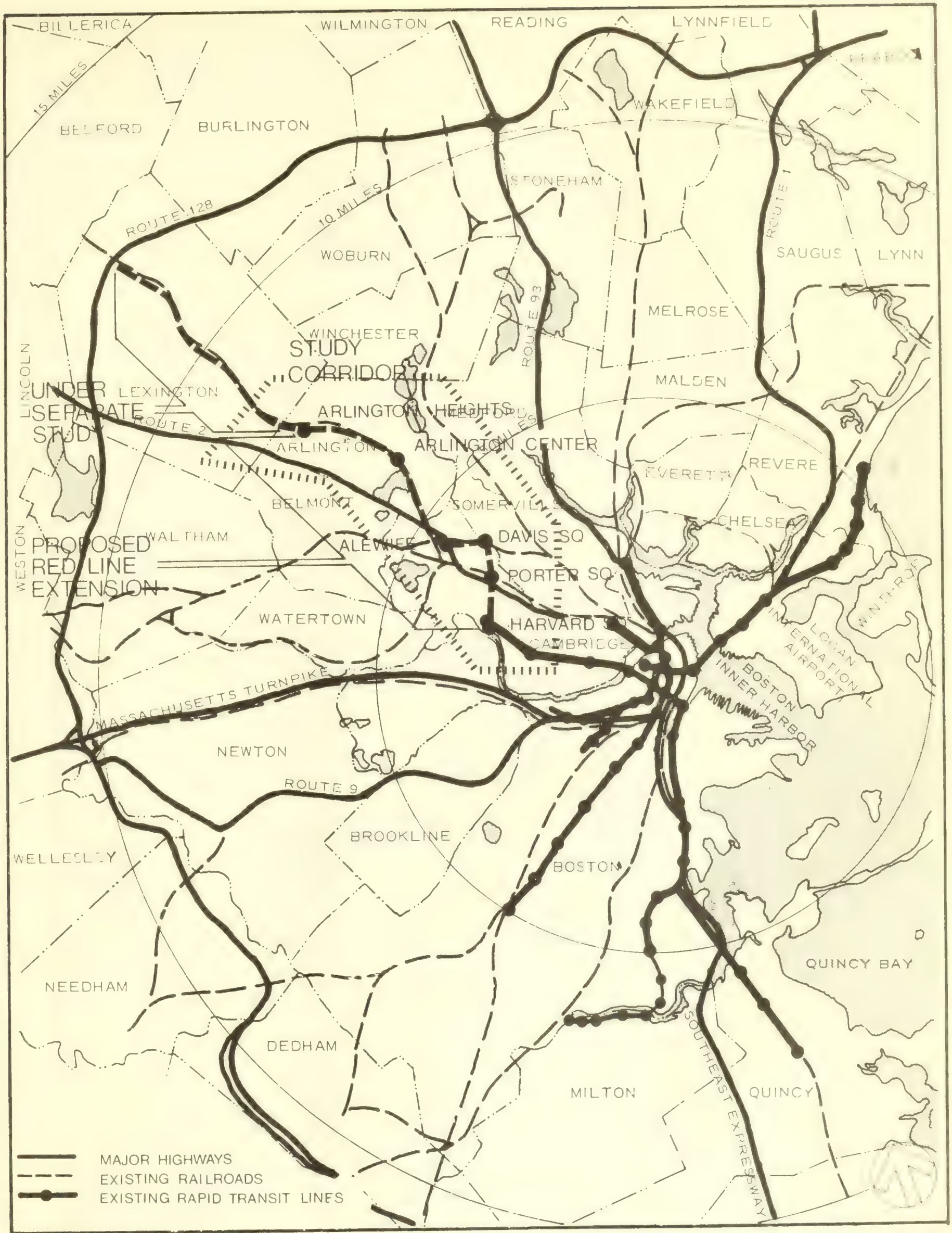
Revised Program for Mass Transportation, MBTA, January 1969.

Staff Supplementary Report to the Program for Mass Transportation, MBTA, August 1966.

Ten Year Transit Development Program, 1974-1983, MBTA, 1974.

The Planning and Community Development Department in each community furnished selected reference material that was concerned with studies and reports prepared for that specific area. In addition to the above material, copies of technical memos, current graphics and maps showing the various transit line and station alternatives, and copies of the minutes from the station area Task Force and Transportation Advisory Group meetings were also on file.

Pre-addressed and stamped comment cards were placed in the project libraries for the convenience of those who might have questions or comments concerning the reference material or the project in general. A De Leuw, Cather & Company staff member responded to each request.



Massachusetts Bay Transportation Authority

RED LINE EXTENSION
STUDY CORRIDOR
FIG 1-1

VIII–2

II–1E

VII–2

II–1D

V–2

VI–2

IV–2

II–1C

II–1B

ARLINGTON

BELMONT

CAMBRIDGE

SOMERVILLE

Waverley

Fresh Pond

Payson Park

Massachusetts Bay Transportation Authority

PROPOSED ALIGNMENT – KEY MAP

0 500 1000 2000

FIG. I-2

ARLINGTON HEIGHTS

A

ARLINGTON

ARLINGTON CENTER

C

B

A

C

B.2

DAVIS SQUARE

ALEWIFE

B.5

A

CUTTER SQUARE ALIGNMENT

DAVIS SQUARE ALIGNMENT

A

A

B.4

PORTER SQUARE

FITCHBURG MAINLINE ALIGNMENT

B.1

C

GARDEN STREET ALIGNMENT

HARVARD SQUARE

D.1

BELMONT

CAMBRIDGE

SOMERVILLE

Fresh Pond

Waverley

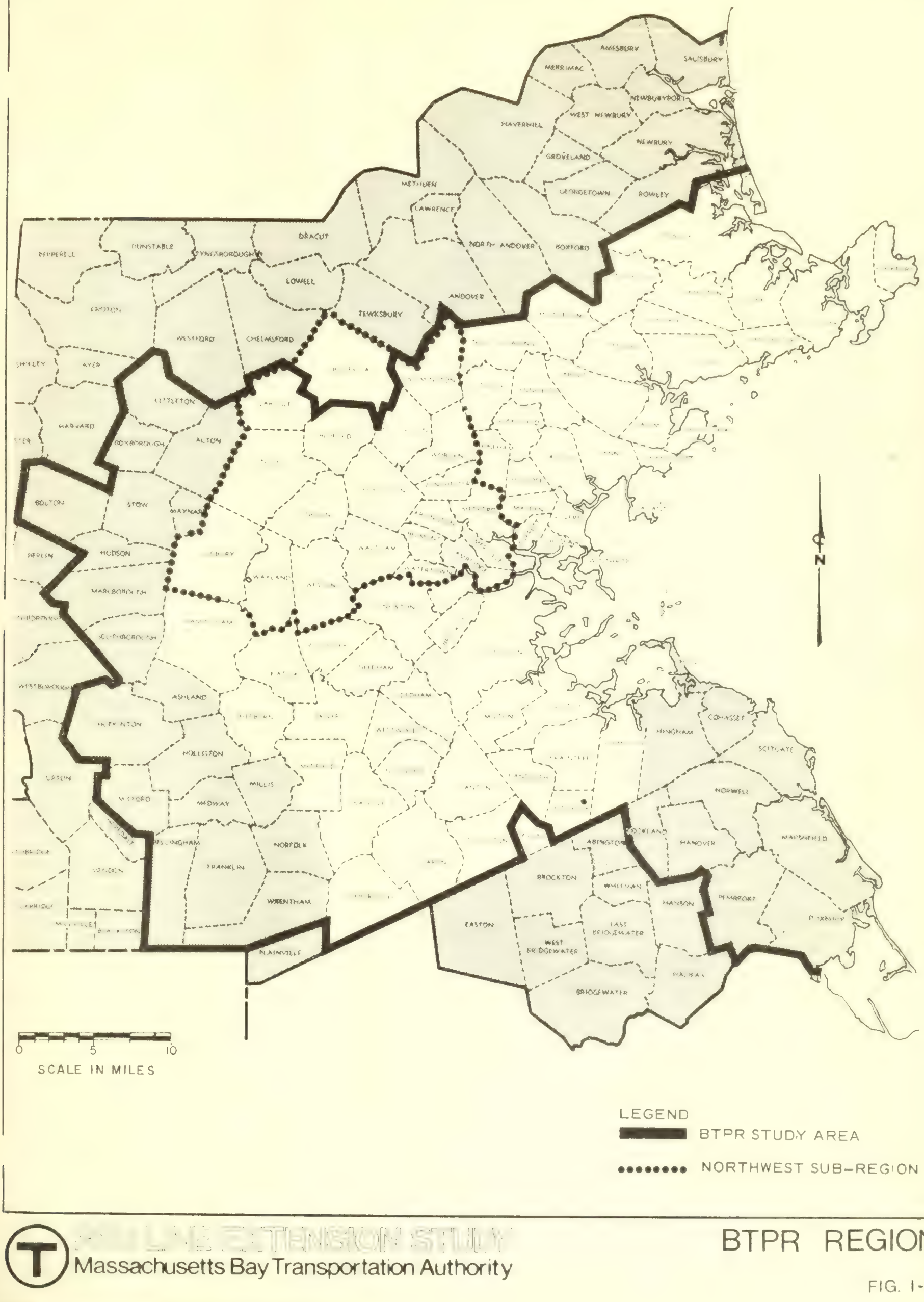
Payson Park

RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

BTPR ALTERNATIVE ALIGNMENTS AND STATION LOCATIONS

500 1000 2000

FIG. I-3



Massachusetts Bay Transportation Authority

BTPR REGION

FIG. 1-4

SOURCE: BTPR

RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

AREAS OF ANALYSIS

FIG. I-5

Chapter II

GENERAL PROJECT DESCRIPTION AND REGIONAL CONSIDERATIONS

Chapter II

GENERAL PROJECT DESCRIPTION AND REGIONAL CONSIDERATIONS

PROJECT DESCRIPTION

The project is an approximately 6.5 mile extension of the MBTA Red Line Rapid Transit from the present terminus at Harvard Square to Arlington Heights in the town of Arlington, Massachusetts. See Figures II-1a to II-1e.

The alignment coincides with Alternative 3 as identified in the BTPR Red Book. The length of each line segment and station area as well as the proposed method of construction are summarized in Table II-1. From a cut-and-cover segment through Harvard Square, the route proceeds north in tunnel/deep bore, generally following Massachusetts Avenue to Davis Square in Somerville. The route then turns west on the Fitchburg Freight Cutoff of the MBTA South Acton Commuter Rail Line to Alewife just south of Dewey and Almy Circle where Route 2 from the west terminates at the Alewife Brook Parkway. Through Freight Service would be discontinued on the Freight Cutoff from east of Grove Street (Davis Square area) in a direction towards Alewife to a point just east of Alewife Brook Parkway in Cambridge. Equivalent through freight service will be provided by increasing clearances of existing bridges.

The route proceeds northwest from Alewife along the Lexington (Bedford) Branch of the MBTA Commuter Rail System to Arlington Heights. Commuter operations were discontinued in March 1977. Freight operations would be displaced. This requires approval by the Interstate Commerce Commission (ICC). According to Purchase and Sale Agreement between B & M and MBTA, discontinuance does not have a time limitation upon ICC approval.

The Harvard Square Station would be rebuilt in a new location and new stations would be constructed at five other locations studied in detail in this report. These are: Porter Square in Cambridge, Davis Square in Somerville, Alewife in Cambridge, Arlington Center and Arlington Heights in Arlington. Each of these stations areas is discussed in separate chapters. Parking spaces for 2,000 vehicles would be provided at Alewife and 350 at Arlington Heights. No new parking would be provided at Harvard Square, Porter Square, Davis Square and Arlington Center.

A more detailed description follows.

Table II-1

PROJECT ALIGNMENT CHARACTERISTICS

Segment	Length In Feet	Type of Structure	Alignment Conditions: Horizontal	Vertical	Crossovers	Lay-Up Track
Harvard Square Station Complex	1,220	Tunnel/ Cut-and-Cover	250 Foot Min. Radius 4,018 Foot Radius at Station	0.5% Minimum 4.0% Maximum 0.5% at Station	South of Harvard Sq.	None
Harvard Square to Porter Square	4,470	Tunnel/ Deep-Bore	700 Foot Min. Radius (Inbound) 740 Foot Min. Radius (Outbound)	0.34% Minimum 4.0% Maximum	None	None
Porter Square Station	440	Tunnel/ Cut-and-Cover	Tangent	0.0%	N/A	N/A
Porter Square to Davis Square	3,040	Tunnel/ Deep-Bore	680 Foot Min. Radius (IB) 720 Foot Min. Radius (OB)	0.3% Minimum 4.0% Maximum	None	None
Davis Square Station	440	Tunnel/ Cut-and-Cover	Tangent	0.0%	N/A	N/A
Davis Square to Alewife	4,730	Tunnel/ Cut-and-Cover	400 Foot Min. Radius (IB) and (OB)	0.46% Minimum 1.26% Maximum	West of Davis Square & East of Alewife	None
Alewife Station	440	Tunnel/ Cut-and-Cover	Tangent	0.0%	N/A	N/A
Alewife to Arlington Center	7,430	Tunnel/Cut-and-Cover	400 Foot Min. Radius (IB) and (OB)	0.0% Minimum 1.70 % Maximum	North of Alewife and South of Arlington Ctr.	1200 Feet North of Alewife
Arlington Center Station	440	Tunnel/ Cut-and-Cover	4,000 Foot Radius at Station	0.0%	N/A	N/A
Arlington Center to Arlington Heights	10,130	Tunnel/Cut-and-Cover	1,100 Foot Min. Radius	0.0% Minimum 2.64 % Maximum	South of Arlington Heights	None
Arlington Heights Station	440	Tunnel/Cut-and-Cover	Tangent	0.0%	N/A	N/A
Turnback and Storage	1,210	Tunnel/Cut-and-Cover		0.0%	North of Arlington Heights	to 850 Feet North of Arlington Heights
TOTAL	34,430					

The extension would commence at the existing platform area at Harvard Square. From Holyoke Street, tracks in separate tunnels would turn north on a 250-foot-radius curve into Massachusetts Avenue, then enter a new station platform area extending from about Church Street to Flagstaff Park. From the station, tracks would proceed northerly on a slight "S" curve to about Waterhouse Street and continue north in tunnel/deep bore under Massachusetts Avenue. In profile, the existing bi-level track configuration would be retained through the new Harvard Square platform area, with tracks converging to a side-by-side configuration north of the station. Tracks would descend on a relatively steep downward grade (4.0 percent) before entering the new platform area. This descent would limit cut-and-cover work in Massachusetts Avenue by permitting tunnel boring to begin at the north end of Flagstaff Park.

In tunnel/deep bore, tracks would proceed northerly under Massachusetts Avenue to a station at Porter Square, just beyond and below the existing MBTA commuter rail station.

North of Porter Square Station, tracks in tunnel/deep bore would underpass the Porter Square Shopping Center and residential areas, curving left under College Avenue and Holland Street to the proposed Davis Square Station in the Fitchburg Freight Cutoff right-of-way. The Davis Square Station would be constructed by cut-and-cover methods. The Porter Square Station would be constructed by rock mining methods except for the mezzanine and the pedestrian tunnel under Massachusetts Avenue.

From Davis Square Station, the extension would proceed west in tunnel/cut-and-cover within the Fitchburg Freight Cutoff right-of-way. The horizontal alignment would generally parallel the present railroad alignment to minimize impacts to surrounding residential and commercial properties. Tunnel/cut-and-cover construction would permit the profile to be raised, while allowing sufficient space for major utility crossings or relocations.

At about Harvey Street, the tracks in tunnel/cut-and-cover would leave the Fitchburg Freight Cutoff right-of-way, pass under Russell Field and W. R. Grace, Inc. property and continue to the proposed Alewife Station, which straddles the Alewife Brook Parkway. From Alewife Station, the extension would turn sharply north to enter the Lexington (Bedford) Branch right-of-way. Tracks, in tunnel/cut-and-cover, would continue in railroad right-of-way to Arlington Center Station at Massachusetts Avenue, then to Arlington Heights Station west of Park Avenue.

The six proposed stations, analyzed in this report and identified on Figure II-1 (B through E) are located as follows:

- Harvard Square - New station platforms would be constructed under Harvard Square extending underground to Flagstaff Park. Other portions of the existing station would be redeveloped and the north leg of the bus tunnels would be relocated.

- Porter Square - The new station would be located under the MBTA Commuter Rail Line just east of Massachusetts Avenue, crossing Somerville Avenue and extending into the Porter Square Shopping Center parking area. It is the deepest station on the proposed extension--constructed in rock. This is a refined version of the alternative identified in the BTPR Red Book as Station B. This would be a major intermodal connection to commuter rail service on the Fitchburg Main Line of the MBTA Commuter Rail System.

- Davis Square - The station would be constructed in the Fitchburg Freight Cutoff right-of-way, crossing under College Avenue and Holland Street. This is an evolution of what the BTPR Study identified as Location B.

- Alewife - A station would be built beneath the Alewife Brook Parkway on an east-west axis immediately south of the Fitchburg Freight Cutoff. This is an adaptation of the BTPR Alternative B. A single 2,000-car parking garage would be constructed west of the Alewife Brook Parkway. Access to garage would be from the Alewife Brook Parkway and Rindge Avenue.

- Arlington Center - The station is a modified version of the BTPR Alternative A. It would be constructed in the Lexington Branch right-of-way at the intersection of Massachusetts Avenue and Swan Place in the central business district.

- Arlington Heights - The station would be built adjacent to the Lexington Branch right-of-way on land between Park Avenue and Drake Road owned by the MBTA.

The total ridership demand for the project (Harvard Square to Arlington Heights) has been estimated by CTPS to be 47,600 daily inbound trips, with no parking constraints. However, community policy positions, based on perceived space limitations, available capacity on station approach streets and esthetic considerations, have limited the parking supply to 2,350 spaces along the length of the extension. According to CTPS park-and-ride demand estimates, this supply constraint would result in an excess parking demand of 5,650 vehicles (or 6,780 persons) per day, assuming a turnover of five percent of the total demand. Approximately 1,050 persons from this excess vehicle demand would be diverted to other modes of access to Red Line Extension stations. Ridership demand and feasible route networks for feeder bus service, one of the station access modes, would require an estimated 244 peak-hour bus arrivals at these stations based on the CTPS and MBTA supply strategies. More detailed planning and programming for the feeder bus service would occur during later stages of the project. The remaining park-and-ride demand excess (5,130 persons) would choose either to make their trips by auto or seek on-street parking near the stations. As a consequence, the resulting total ridership demand with limited parking supply is estimated to be 42,700 inbound trips, approximately a ten percent reduction from the unconstrained forecast demand.

Despite the magnitude of the project, land acquisition requirements and displacement have been kept to an absolute minimum by routing transitways within existing transportation rights-of-way and by maximum tunnel/deep bore construction. A summary of land acquisition and permanent easements by town and land use type is shown in Table II-2.

TABLE II-2

RIGHT-OF-WAY REQUIREMENTS

Address	Type	Use
Cambridge		
1320-1324 Massachusetts Avenue	Commercial	Construction Easement
1326-1328 Massachusetts Avenue	Commercial	Construction Easement
1358-1362 Massachusetts Avenue	Commercial	Utility & Construction Easements
1350-1354 Massachusetts Avenue	Commercial	Utility & Construction Easements
1336-1346 Massachusetts Avenue	Commercial	Utility & Construction Easements
1372-1376 Massachusetts Avenue	Commercial	Construction Easement
1380-1392 Massachusetts Avenue	Commercial	Construction Easement
Harvard Yard	Institutional	Permanent, Utility and Construction Easements
Old Burying Ground	Historic	Construction Easement
1448-1454 Massachusetts Avenue	Commercial	Construction Easement
1416-1442 Massachusetts Avenue	Commercial	Construction Easement
1511 Massachusetts Avenue	Institutional	Partial Taking/Construction Easement
Gannett House (Massachusetts Avenue)	Institutional	Partial Taking/Construction Easement
Flagstaff Park	Public Park	Permanent & Construction Easements
Cambridge Common	Public Park	Permanent Easement
North Little Common	Public Park	Permanent Easement
1599 Massachusetts Avenue (Garage)	Institutional	Construction Easement
6-8 Everett Street (Garage)	Institutional	Construction Easement
1601 Massachusetts Avenue (Garage)	Institutional	Partial Taking/Construction Easement
1603 Massachusetts Avenue (Garage)	Institutional	Partial Taking/Construction Easement
1699 Massachusetts Avenue (Midget Parking Lot)	Commercial	Partial Taking/Permanent & Construction Easements
1815-1843 Massachusetts Avenue (Sears)	Commercial	Partial Taking/Permanent, Construction & Utility Easements
1847-1853 Massachusetts Avenue (Commonwealth Lock)	Commercial	Permanent & Construction Easements
1855-1867 Massachusetts Avenue (Flag Store Group)	Commercial	Total taking of land and structures for station structures
835 Somerville Avenue (Professional Building)	Commercial	Total Taking of land and structures for station structures
821-830 Somerville Avenue (Dodge Dealer)	Commercial	Permanent, Utility & Construction Easements
1-55 White Street (Porter Square Shopping Center)	Commercial	Partial Taking/Permanent, Utility & Construction Easements

TABLE II-2

RIGHT-OF-WAY REQUIREMENTS

Address	Type	Use
1890-1906 Massachusetts Avenue	Commercial	Total Taking
1-3 Orchard Street	Residential	Permanent Easement
2-4 Orchard Street	Residential	Permanent Easement
9 Orchard Street	Residential	Permanent Easement
11 Orchard Street	Residential	Permanent Easement
13-15 Orchard Street	Residential	Permanent Easement
17 Orchard Street	Residential	Permanent Easement
2-6 Saginaw Avenue	Residential	Permanent Easement
12 Saginaw Avenue	Residential	Permanent Easement
16-22 Saginaw Avenue	Residential	Permanent Easement
140 Elm Street	Residential	Permanent Easement
24 Beech Street	Residential	Permanent Easement
22 Beech Street	Residential	Permanent Easement
Somerville		
4 Willow Avenue	Residential	Permanent Easement
8-10 Willow Avenue	Residential	Permanent Easement
151 Elm Street	Residential	Permanent Easement
153-155 Elm Street	Residential	Permanent Easement
157 Elm Street	Residential	Permanent Easement
161-163 Elm Street	Residential	Permanent Easement
5-7 St. James Street	Residential	Permanent Easement
9-9A St. James Street	Residential	Permanent Easement
14 St. James Street	Residential	Permanent Easement
16 St. James Street	Residential	Permanent Easement
20 St. James Street	Residential	Permanent Easement
22 St. James Street	Residential	Permanent Easement
26 St. James Street	Residential	Permanent Easement
21 Windom Street	Residential	Permanent Easement
11 Elston Street	Residential	Permanent Easement
15 Elston Street	Residential	Permanent Easement
19 Elston Street	Residential	Permanent Easement
23 Elston Street	Residential	Permanent Easement
25-27 Elston Street	Residential	Permanent Easement
24 Elston Street	Residential	Permanent Easement
344-344A Summer Street	Residential	Permanent Easement
346-348 Summer Street	Residential	Permanent Easement
345-349 Summer Street (Vent Shaft)	Residential	Partial Taking/Permanent & Construction Easements
351-357 Summer Street	Private Parking	Permanent & Construction Easements
44 Hawthorne Street	Residential	Permanent Easement
46-46A Hawthorne Street	Residential	Permanent Easement
48-50 Hawthorne Street	Residential	Permanent Easement
52-54 Hawthorne Street	Residential	Permanent Easement
49-51 Hawthorne Street	Residential	Permanent Easement
53-55 Hawthorne Street	Residential	Permanent Easement
57-59 Hawthorne Street	Residential	Permanent Easement

TABLE II-2

RIGHT-OF-WAY REQUIREMENTS

Address	Type	Use
56 Hawthorne Street	Residential	Permanent Easement
7 Elston Street	Residential	Permanent Easement
385 Highland Avenue	Residential	Permanent Easement
23-25 Cutter Avenue	Residential	Permanent Easement
27-29 Cutter Avenue	Residential	Permanent Easement
31-33 Cutter Avenue	Residential	Permanent Easement
378-382 Highland Avenue	Residential	Permanent Easement
384-384A Highland Avenue	Residential	Permanent Easement
386 Highland Avenue	Residential	Permanent Easement
387-389A Highland Avenue	Residential	Permanent Easement
393 Highland Avenue	Residential	Permanent Easement
Grove Street @ Highland Avenue	Parking	Permanent Easement
401 Highland Avenue	Commercial	Permanent & Construction Easements
403-405 Highland Avenue	Commercial	Permanent & Construction Easements
Rear 407 Highland Avenue	Commercial	Permanent & Construction Easements
Rear 409-411 Highland Avenue	Commercial	Partial Taking/Permanent, Utility & Construction Easements
421-431 Highland Avenue	Commercial	Construction Easement
30 Ellington Road	Residential	Permanent Easement
42 Grove Street	Residential	Permanent Easement
1 College Avenue	Commercial	Total Taking
11-15 College Avenue	Vacant Land	Total Taking
17-21A College Avenue	Commercial	Construction Easement
Rear 17-21A College Avenue	Commercial	Partial and/or Total Taking Construction Easement
16 Holland Street	Commercial	Total Taking of Land and Structure
18-24 Holland Street	Commercial	Construction Easement
26-30 Holland Street	Commercial	Construction Easement
32 Holland Street	Commercial	Construction Easement
18 Winter Street	Commercial	Construction Easement
12-16 Winter Street	Commercial	Construction Easement
12-14 College Avenue	Commercial	Construction Easement
5-17 Holland Street	Commercial	Construction Easement
45-48 Davis Square	Commercial	Total Taking of Land and Structure
3 Holland Street	Commercial	Construction Easement
296-304 Elm Street	Commercial	Construction Easement
79-81 Meacham Road	Residential	Construction Easement
99-119 Dover Street	Commercial	Construction Easement
6 Elm Court	Residential	Construction Easement
413 Highland Avenue	Commercial	Construction Easement

TABLE II-2
RIGHT-OF-WAY REQUIREMENTS

Address	Type	Use
65 Meacham Road	Commercial	Permanent & Construction Easement
67 Meacham Road	Commercial	Permanent Easement
69 Meacham Road	Commercial	Total Taking
11 Lester Terrace	Residential	Construction Easement
38 Thorndike Street	Residential	Construction Easement
41 Thorndike Street	Residential	Construction Easement
43-45 Thorndike Street	Residential	Construction Easement
25 Kingston Street	Residential	Construction Easement
27-29 Kingston Street	Residential	Construction Easement
31 Kingston Street	Residential	Construction Easement
33 Kingston Street	Residential	Construction Easement
35 Kingston Street	Residential	Construction Easement
37 Kingston Street	Residential	Construction Easement
43 Kingston Street	Residential	Construction Easement
6 Campbell Park Place	Residential	Construction Easement
42 Locke Street	Residential	Construction Easement
Rear Howard Street	Industrial	Construction Easement
39 Thorndike Street	Residential	Construction Easement
Lot 98 Buena Vista Rd.	Vacant	Construction Easement
Cambridge		
42 Locke Street	Residential	Construction Easement
42-46 Lock Street	Residential	Construction Easement
48 Locke Street	Residential	Construction Easement
2409 Massachusetts Avenue	Commercial	Construction Easement
2464 (Rear) Massachusetts Avenue	Industrial	Construction Easement
35 Harvey Street	Residential	Construction Easement
45 Harvey Street	Commercial	Construction Easement
2448-2464 Massachusetts Avenue	Commercial	Partial Taking
173 Harvey Street	Industrial	Construction Easement
149-163 (Rear) Harvey Street	Industrial	Construction Easement
End Harvey Street	Industrial	Construction Easement
128 Clifton Street	Residential	Construction Easement
222 Harvey Street	Industrial	Permanent Easement
End Harvey Street	Industrial	Permanent Easement
124 Clifton Street	Industrial	Permanent Easement
82-124 (Rear) Clifton Street	Recreational	Permanent Easement
Metropolitan Parkway	Industrial	Permanent Easement
End Harvey Street	Industrial	Permanent Easement
121-123 Alewife Brook Parkway	Commercial	Total Taking
465-467 Rindge Avenue	Commercial	Total Taking

TABLE II-2
RIGHT-OF-WAY REQUIREMENTS

Address	Type	Use
527-559 Rindge Avenue	Commercial	Total Taking
520-560 Rindge Avenue	Industrial	Total Taking
25 Rindge Avenue	Industrial	Total Taking
35 Rindge Avenue Extension	Industrial	Partial Taking
Alewife Brook Reservation	Open Space	Permanent Easement
196 Rindge Avenue Extension	Commercial	Construction Easement
Arlington		
Lake Street Parking Lot	Public	Permanent Easement
10-42 Hamilton Road	Residential	Permanent Easement
590 Massachusetts Avenue	Commercial	Permanent Easement
Swan Place and Massachusetts Avenue	Commercial	Permanent Easement
Whittemore Park	Public	Permanent Easement
Coolidge Bank Parking Lot	Commercial	Permanent Easement
Town of Arlington	Public	Partial Taking
Arlington	Public	Permanent Easement
1345 Massachusetts Avenue	Commercial	Partial Taking
Brattle Street	Industrial	Permanent Easement
53A Park Avenue	Commercial	Total Taking
Colonial Village Parking Lot	Residential	Partial Taking

Relationship to Commuter and Freight Rail Operations

Existing rail lines are shown on Figure I I-4. Construction of the Red Line Extension along the right-of-way of the Freight Cutoff and Lexington Branch would affect both commuter and freight rail operations. Commuter rail on the Lexington Branch was abandoned in March 1977. Freight rail lines are to be abandoned prior to Red Line construction.

The Red Line Extension to Arlington Heights would replace the former commuter rail service that served Arlington and would eliminate direct service to the communities of Lexington and Bedford.

Removal of the tracks of the Freight Cutoff between east of Alewife Brook Parkway in Cambridge and west of Grove Street in Somerville would require the rerouting of Boston and Maine through freight trains into the Somerville Yard complex by New Hampshire Division Lines. The rerouting would require clearance improvements to the line. The improvements require lowering tracks from 6 to 12 inches in order to provide a published vertical clearance of 17'-0".

Local freight service to siding and team track customers presently receiving service on the Freight Cutoff would be maintained during and after construction. The portion of the track from a point just east of Alewife Brook Parkway to a point just east of Grove Street would be permanently removed. Customers located east of Grove Street would be served by way of access from the New Hampshire Main Line located at the east end of the Freight Cutoff. Other customers would be served by the B & M's West Cambridge Yards. Approval by the Interstate Commerce Commission would not be required.

Abandonment of local freight service on the Lexington Branch beyond the Bethlehem Steel plant at Alewife Brook would require either the substitution of off-line team track service and piggyback rail freight service or the relocation of customers affected by the project. Abandonment of the Lexington Branch would require approval of the Interstate Commerce Commission.

The yards and branches of both the MBTA and the Boston and Maine affected by the Red Line Extension are shown in Figure II-4.

Presently, rail freight service on the Lexington Branch to Hanscom Air Force Base in Bedford is not required for normal operations at the Base. However, it is the Air Force's current position that rail service would be required in the event of a national emergency. Assuming that there are no signficant modifications in this defense policy and/or the existing rail network, the most viable of several possible alternatives appears to be the relaying of track on the existing North Billerica to Bedford right-of-way.

Construction Easements

In order to construct the tunnel/deep bore portions of the project, it would be expedient to utilize construction shaft sites and work areas for which temporary construction easements would be required. It is proposed that a construction shaft be

located along the Fitchburg Division tracks at Porter Square. The work area would generally incorporate facilities for short-term storage of excavated materials, since it is not possible to haul such material away continuously. Excavated materials would be transported on short-haulroads built along the railroad tracks. Material would be deposited at locations to be determined which will be subject to approval by the Department of Environmental Quality Engineering and in accordance with Massachusetts law. Construction easements may be necessary along the railroad right-of-way for the construction of temporary haul roads. More definite construction easement requirements cannot be established until the final design phase. For more specifics, see Page II-192, "Disposal of Excavated Materials".

Method, Duration and Sequence of Construction

The land uses along the route have influenced the proposed method of construction. Profiles and construction methods are indicated in Table II-1 and Figure II-3. All stations would be constructed by cut-and-cover methods with the exception of the Porter Square Station, which will be constructed by rock mining methods except for mezzanine and pedestrian tunnels. Below-grade construction in the Lexington Branch and Freight Cutoff right-of-way would be tunnel/cut-and-cover. For the tunnel/deep-bore, twin section tubes, about 20 feet in diameter, each with a single track, would be built rather than a more costly single 34-foot-diameter tube accommodating double tracks. A double-box concrete structure is recommended for tunnel/cut-and-cover sections, with variable-width transition sections at connections with tunnel/deep bore.

Harvard Square Complex

Cut-and-cover methods would be used to construct the project from the point of track tie-in to a point in Massachusetts Avenue near Cambridge Street where sufficient depth would be reached for tunnel/deep bore construction. Project elements in the cut-and-cover section include transit tunnels, the new platform area, a temporary station, and the relocated section of bus tunnels.

Construction would be phased to minimize traffic disruption. Temporary traffic rerouting together with temporary decking would permit near-normal traffic operation while construction proceeded below the decking. The eventual removal of the temporary cover and reconstruction of street surface would follow a similar sequential pattern.

Where excavation passes near Lehman Hall, Straus Hall, Wadsworth, and other buildings, a slurry wall would be constructed. The need to underpin this and other nearby buildings in the project area is considered unlikely.

Relocation of the north legs of the bus tunnels would necessitate on-street operation of buses and trolleys. It is proposed that on-street operation be modified but that it continue for the duration of the construction period. This type of operation would free tunnels and ramps for use in moving equipment and materials into and out of the construction site. This ready-made access would measurably lessen the impact of construction operations in the Harvard Square area.

Since the proposed project requires the reconstruction and relocation of the existing Harvard Square Station, it will be necessary to construct two "temporary" Harvard Square Stations to permit the continuation of revenue service during the construction period.

The temporary station in Harvard Square would be constructed between Dunster and Holyoke Streets under the south side of Massachusetts Avenue. It would mirror the present station and consist of an upper, outbound platform and a lower, inbound platform.

A second temporary transit passenger area, in the MBTA train yard immediately beyond the Elliot Street tunnel portal, would also be provided. This station would be in close proximity to the trackless trolley turn-around at the Harvard Motor Inn area of Mount Auburn Street and would thus serve the relatively large numbers of transit passengers who transfer to the Watertown and Waverly trackless trolleys.

Harvard Square to Porter Square - Line Segment

Two methods of construction would be utilized for the segment of subway between Harvard Square and Porter Square. Beginning at Harvard Square and continuing to a point on Massachusetts Avenue near the Hemenway Gym, the tunnel/cut-and-cover method would be used. Beyond the Hemenway Gym to the beginning of Porter Square, the subway would be constructed via the tunnel/deep bore method. Compressed air would not have to be used to eliminate water from the construction site.

The deep bore tunneling method was chosen over the cut-and-cover method because it will lessen the impact during construction on the surrounding neighborhoods. Specifically, the deep bore method negates the need to tear up Massachusetts Avenue, which runs along most of the length of this section and which, if narrowed to half its width, would cause severe traffic congestion problems. Additionally, shops along this section of Massachusetts Avenue, which number between 40 and 50, would incur substantial economic losses due to a temporary loss of customer parking spaces, advertising exposure, and customer accessibility. Additionally, similar situations where cut-and-cover construction has occurred have resulted in numerous suits being brought against the Authority for structural damages to buildings along the right-of-way.

Tunnel boring toward Harvard Square would begin from a construction shaft located at Porter Square. This is a particularly desirable location for a construction shaft because of its proximity to the existing Fitchburg Main Line right-of-way.
Railroad land would be made available for the construction of a private access road and also railroad operations would facilitate the supply of construction materials and provide the necessary facilities for disposing of excavated material.

The Porter Square Station would be constructed by rock mining methods except for the mezzanine and the pedestrian tunnel under Massachusetts Avenue. The mezzanine would be constructed by cut-and-cover; the pedestrian tunnel by tunneling. In addition to the actual station construction, some construction would be required to maintain existing service and structures.

Maintenance of vehicular traffic on Somerville Avenue and railroad operations along the Fitchburg Division will be major factors during the construction period. Open construction work on Massachusetts Avenue would be minimized, as the major station area would be east of the avenue. Traffic on Somerville Avenue would be maintained by temporary decking.

Porter to Davis - Line Segment

A tunneling machine would be utilized for construction of the subway between Porter Square and Davis Square. A construction shaft would be located at Porter Square and the tunnel boring would begin from there. Upon completion of one tube, the tunneling machine would be dismantled and sent back to Porter Square, where it would be reassembled to complete the other tube. Locating the construction shaft at Porter Square would be desirable due to the proximity of the existing Fitchburg Main Line right-of-way. Railroad land would be made available for transport of excavation materials and construction supplies and materials.

Again, the deep bore tunneling method was chosen over the cut-and-cover method because of its lesser impact on the surrounding environment. Using a cut-and-cover method would involve the total taking of 30 to 40 residential properties causing the displacement of 40 to 60 families. Additionally, material handling to and from the construction site would place an extreme burden on local residential streets because of their inability to handle such activities.

Construction of the Davis Square Station would be by the cut-and-cover method. A deck would be provided so that vehicular traffic could be maintained on College and Highland Avenues and Holland Street. Underpinning of nearby buildings is not anticipated to be required.

Davis to Alewife - Line Segment

This section of the project would be constructed along the railroad right-of-way and across Russell Field and other private properties. A number of permanent easements and land takings would be required. The specific properties involved and the type of taking or easement required are indicated in Table II-2.

Tunnel/cut-and-cover construction would be utilized for this section of the project. Intersections at Cameron Avenue and Massachusetts Avenue would require decking during construction to permit the uninterrupted flow of vehicular and pedestrian traffic.

Traffic maintenance on Alewife Brook Parkway is a major concern. A bypass roadway on embankment will be constructed between the Freight Cutoff bridge and Rindge Avenue. After constructing the portion of the station under the Parkway and the pedestrian underpass, the bypass will be eliminated.

Alewife to Arlington Center - Line Segment

The entire portion of transit construction along this segment of the Red Line Extension would be in a tunnel/cut-and-cover profile.

Cut-and-cover construction between Alewife Station and Route 2 would require temporary relocation of Alewife Brook prior to excavation. Once the box section for the tunnel/cut-and-cover has been completed and covered over, Alewife Brook would be relocated to its original channel. Tunnel/cut-and-cover construction would continue to Arlington Heights and will incorporate a 1,200-foot turnback and layup facility beyond Alewife Station.

Arlington Center to Arlington Heights - Line Segment

The entire transit line in Arlington would be of tunnel/cut-and cover construction.

Certain buildings may require some protective measures to prevent ground movements and surface settlements caused by construction. The needs of each particular case would be studied and conventional underpinning will be used where no other acceptable alternative is practical. In many cases, grouting or cutoff walls may be more effective than underpinning.

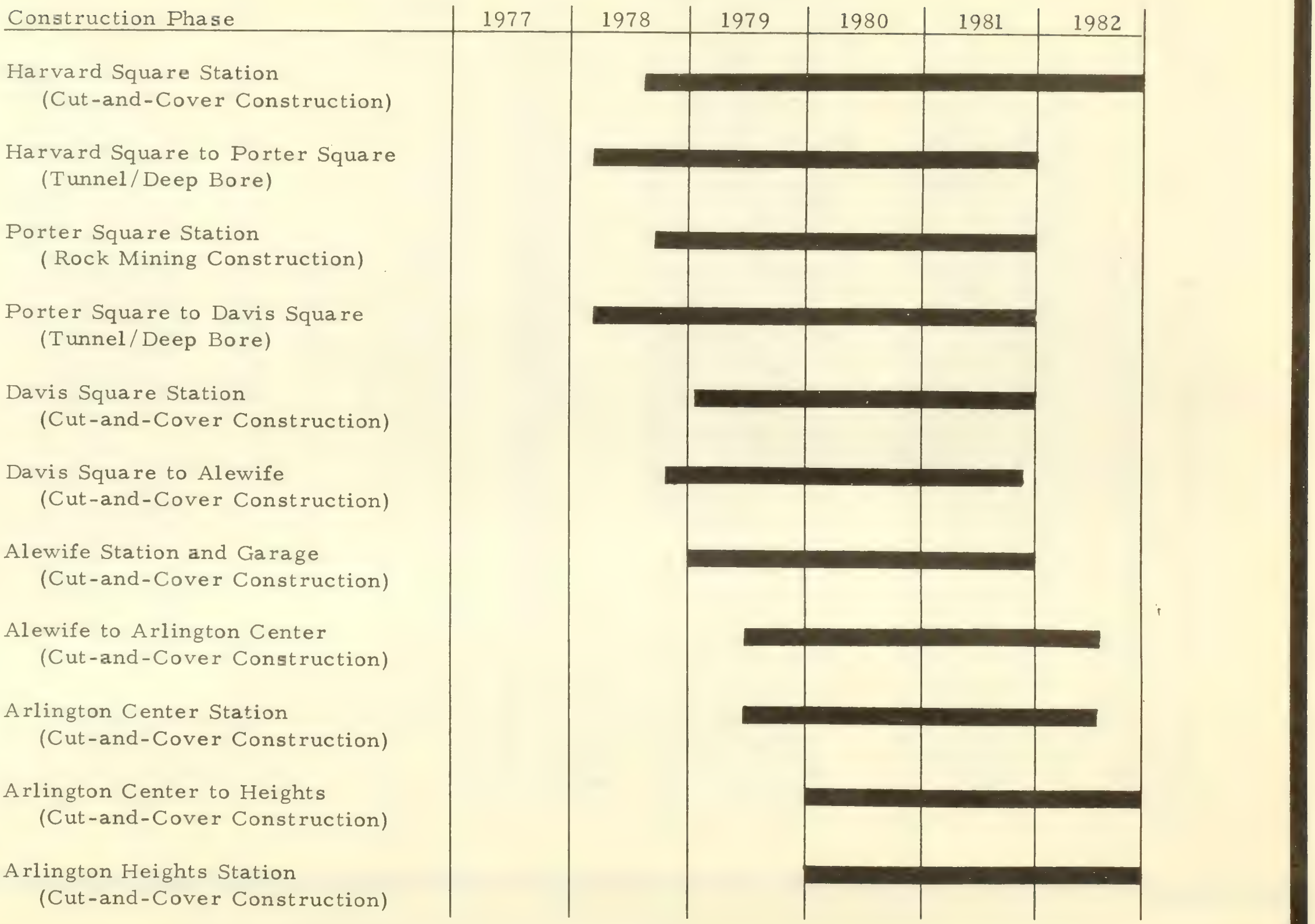
Construction would progress from Arlington Center to Arlington Heights. The existing railroad could be utilized to deliver and remove materials west of the work force. Handling materials via the railroad would minimize trucking impacts on local streets in the populated areas of Arlington. In less populated areas materials could be transferred to trucks for final disposition. In areas where the line passes under roadways, traffic would either be rerouted to adjacent streets or temporary bypass routes built for use until temporary decking is in place.

Schedule

Under the proposed construction schedule, the project would be completed in approximately four and one-half years. See Table II-3.

Table II-3

HARVARD SQUARE TO ARLINGTON HEIGHTS
ESTIMATED CONSTRUCTION SCHEDULE


Construction Phase
1977
1978
1979
1980
1981
1982
Harvard Square Station (Cut-and-Cover Construction)
Harvard Square to Porter Square (Tunnel/Deep Bore)
Porter Square Station (Rock Mining Construction)
Porter Square to Davis Square (Tunnel/Deep Bore)
Davis Square Station (Cut-and-Cover Construction)
Davis Square to Alewife (Cut-and-Cover Construction)
Alewife Station and Garage (Cut-and-Cover Construction)
Alewife to Arlington Center (Cut-and-Cover Construction)
Arlington Center Station (Cut-and-Cover Construction)
Arlington Center to Heights (Cut-and-Cover Construction)
Arlington Heights Station (Cut-and-Cover Construction)

COSTS

The costs of a transportation facility can be separated into two major categories--costs borne by the constructing agency and uncompensated costs and benefits experienced by those affected by the construction operation and availability of the transport facility. The costs borne by the constructing agency, in this case the MBTA, can be further subdivided into capital costs and operating costs. The capital costs have been subdivided into three categories: construction costs, right-of-way costs and relocation costs which include all costs associated with the actual construction of the facility including any special mitigating measures. The various cost components are as follows:

Construction Costs

Structure Construction Cost

This term includes labor, tunneling, primary lining, plant and equipment, concrete work, formwork, sheeting and bracing, drainage, restoring ground to original condition, fencing where required, and other miscellaneous items.

Trackwork

This covers all trackwork, third rail, crossovers, and other special trackwork. Generally, it includes all items necessary to install a rapid transit operation.

Demolition

This item primarily covers the demolition of portions of the existing Harvard Square Station.

Communications

This item includes necessary items for communication systems.

Tunnel Ventilation

The costs provide for normal air ventilation in the tunnel including air escape shafts, emergency exits and necessary mechanical equipment.

Utility Relocation

The estimate provides for temporary and/or permanent relocation of public utilities such as water and sewers to maintain continuous service.

Protection and Repair of Existing Structures

This item includes protection for the buildings, utilities and other structures that could be affected by construction.

Signalization

The necessary items required to provide for a safe operating system are included.

Electrification

This item includes station and tunnel lighting, power and substation installation.

Railroad Trackwork

Segments of the line are along former Boston and Maine operating tracks. Under the various alternatives, there are costs associated with removing the trackwork, replacing certain segments, supporting the tracks, etc., and relocating Freight Cutoff to New Hampshire Division. The costs associated with the railroad have been identified for each project segment and the alternatives.

Parking Garage

This item covers all items involved in the construction of the structural, electrical, mechanical, etc.

Bridge Removal

This item is the cost for removing existing bridges over or under the railroad in Arlington.

Raising and Repaving of Streets

This item involves the reconstruction of streets in Arlington where bridges are being removed.

Floating Slab

In areas where noise and vibration-sensitive structures have been identified, the cost of a floating slab has been added as a mitigating measure.

Other Project Costs

All project costs other than construction costs such as professional services, project administration, field supervision, and force account were developed utilizing UMTA guidelines. Contingencies is based on 10% of construction costs.

Table II-4 shows the cost per section. In Chapters III through VIII the construction costs have been subdivided into the various applicable components. The estimated total construction cost for the project is $614,602.000. The estimates are based on an escalation factor calculated to be midpoint of construction.

Right-of-Way Costs

The two main components of this item are costs for the actual property taken, either total or partial, and permanent easements. The property cost estimates are market values based on a factor times assessed valuations. No property-value appraisals were made for these estimates. A comprehensive policy is currently under development for actually negotiating easement cost.

Table II-4 shows the right-of-way costs per section. The estimated total right-of-way cost for the proposed project is $8,432,000.

Relocation Costs

Included in this category are the costs associated with all required commercial and industrial relocation. It does not include costs to local businesses which might be adversely affected during the construction period. If residential properties were to be taken, then this item would include all costs associated with the provision of acceptable housing for all families who would have to be relocated in accordance with the Uniform Relocation Act.

Table II-4 shows the relocation costs per section. The estimated total relocation cost for the proposed project is $908,000.

The total capital cost for the proposed extension from Harvard Square to Arlington Heights is $625,304.000. For a breakdown per section, see Table II-4.

Table II-4

CAPITAL COSTS
RED LINE EXTENSION
HARVARD TO ARLINGTON HEIGHTS
(Estimate based on midpoint of construction)

Section	Construction Cost*	Right-of-Way Cost*	Relocation Cost	Total
Harvard Square Station Complex	$ 56,590,000	$ 180,000	$ 58,000	$ 55,433,000
Harvard Square to Porter Square	77,996,000	1,890,000	0	79,886,000
Porter Square Station	45,461,000	200,000	100,000	45,761,000
Porter Square to Davis Square	44,632,000	2,129,000	0	46,761,000
Davis Square Station	26,975,000	363,000	250,000	27,588,000
Davis Square to North of Alewife	56,757,000	70,000	0	56,827,000
Alewife Station Complex	42,687,000	2,000,000	300,000	44,987,000
Harvard-Alewife Project Wide Items	26,281,000	0	0	26,281,000
North of Alewife to Arlington Center	36,888,000	50,000	0	36,938,000
Arlington Center Station Complex	14,420,000	1,000,000	0	15,420,000
Alewife-Arlington Center Project Wide Items	16,329,000	0	0	16,329,000
Arlington Center to Arlington Heights	108,653,000	500,000	200,000	109,353,000
Arlington Heights Station Complex	29,333,000	50,000	0	29,383,000

Table II-4 (continued)

Section	Construction Cost*	Right-of-Way Cost*	Relocation Cost	Total
Arlington Center-Arlington Heights Project Wide Items	$ 31,600,000	$ 0	$ 0	$ 31,600,000
SUBTOTAL	$614,602,000	$8,432,000	$908,000	$623,942,000
Retirement of UMTA Loan for Purchase of B & M Railroad Property				1,362,000
			PROJECT TOTAL	$625,304,000

*Includes "Other Project Costs" as defined in Chapter II.

Operating Costs

The cost of transit improvements include the public costs of operating the transit service. The major component of this cost is the marginal cost required to operate the new addition of the system. The other operating cost is due to changes in transit operations during the construction phase. The major portion of this cost is in Harvard Square where the existing transit facilities are disrupted during construction and bus routes are relocated.

TRANSPORTATION BENEFITS

Extension of the Red Line beyond Harvard Square, which would introduce direct, express transit service between the outlying communities of the Northwest Subregion and the Boston CBD, is expected to result in four major types of transportation benefits:

- User Benefits--benefits directly accruing to system users due to improved service quality.
- Regional Benefits--benefits experienced by all residents of the area as a result of the extended service.
- Operator Benefits--benefits experienced by the MBTA through improved system efficiencies.
- Governmental Benefits--benefits to the local, regional, and state governments resulting from increased diversity of feasible transportation policy positions.

User Benefits

The Red Line Extension would afford present and future system users several distinct benefits as a result of improved service quality and transportation opportunities.

- Reduced travel time
- Reduced travel cost
- Improved travel convenience
- Improved access
- Improved mobility

Travel Time

Extension of Red Line service would reduce transit travel time from outlying communities to Cambridge and downtown Boston. The overall time reductions would benefit present transit users and make transit more competitive with the automobile, resulting in approximately 7,675 automobile trips being diverted to transit.

Table II-5 presents estimated average travel times between stations on the Red Line Extension and downtown Boston via automobile, the existing transit system, and the Red Line Extension. The table also indicates the expected time savings with the Extension as compared to the automobile and the existing transit system.

Table II-5

PEAK-PERIOD TRAVEL TIME TO DOWNTOWN BOSTON[a]

From	Travel Time (Minutes)			Time (Minutes) Saved with Red Line Extension	
		Via Transit (b)			
	Via Auto	Existing	Red Line Extension	Auto	Existing
Harvard Square	19	9.6	9.6	9.4	0
Porter Square	21	20.1	12.2	8.8	7.9
Davis Square	21	23.1	13.8	7.2	9.3
Alewife	21	25.4	15.9	5.1	9.5
Arlington Center	22	29.1	18.3	3.7	10.8
Arlington Heights	26	39.1	21.6	4.4	17.5
Lexington Center	36	70.4	26.4	9.4	44.0
Route 128	40	88.6	29.1	10.9	59.5

[a]To Park Street

[b]Includes wait time computed as one-half of composite headways.

NOTE: This project terminates at Arlington Heights. The extension from Arlington Heights to Route 128 would be part of a future improvement.

Significant travel time deficiencies are experienced with the existing transit network serving the Northwest Subregion. Existing transit trips beyond Harvard Square require a transfer between rapid transit and bus modes. Since the bus portion of these trips results in delays due to traffic congestion and additional stops, the transit travel time is substantially greater than the auto travel time. For instance, travel time from Arlington Heights to downtown Boston via the existing transit network (bus plus rapid transit) is approximately 39 minutes, while the trip via automobile takes only 26 minutes. From Harvard Square into Boston, where Red Line service is now provided, the transit trip takes only 9.6 minutes compared to 19 minutes by automobile. Extension of the Red Line beyond Harvard Square would eliminate the travel time inefficiencies which occur with the bus portion of the trips, resulting in a travel time savingsbetween Arlington Heights and Boston of approximately 17.5 minutes over the existing transit system and 4.4 minutes over the automobile.

Table II-6 compares travel time efficiencies, defined as the ratio of existing transit and automobile travel times to Red Line Extension travel times, for trips to downtown Boston and Harvard Square from the proposed stations. These figures indicate that the Red Line Extension would improve travel time efficiencies in the Northwest Subregion.

Studies indicate that for psychological reasons people have varying perceptions concerning the relative comfort and privacy of different modes of travel. The "cost" of time in-transit is perceived as greater than the "cost" of time spent in an automobile. Consequently, in order for the transit system to divert passengers from the auto mode, the actual time spent while in-transit should be less than the time spent in an automobile for the same trip. The time savings achieved by the Red Line Extension would attract a portion of those travelers presently using automobiles.

Table II-6

RED LINE EXTENSION TRAVEL TIME EFFICIENCIES

From	Auto (a)	Existing Transit (b)	To Harvard Square (Existing Transit) (c)
Harvard Square	1.98	1.0	-
Porter Square	1.72	1.65	4.04
Davis Square	1.52	1.67	3.21
Alewife	1.32	1.60	2.51
Arlington Center	1.20	1.59	2.24
Arlington Heights	1.20	1.81	2.46
Lexington Center	1.36	2.67	3.62
Route 128	1.37	3.04	4.27

(a) Auto Time: Rapid Transit Time

(b) Existing Transit Time: Rapid Transit Time

(c) Existing Transit Time to Harvard Square: Rapid Transit Time to Harvard Square.

NOTE: This project terminates at Arlington Heights. The extension from Arlington Heights to Route 128 would be part of a future improvement.

Based on the estimated travel time savings and expected ridership that would occur with a rapid transit extension (including persons diverted from the automobile and users of the existing system), it is estimated that the aggregate time savings accruing to the users of the Red Line Extension would be 5,780 person-hours per day (approximately 1.15 million person-hours per year). If time is given a value of $3.00 per hour, the resultant time savings would represent aggregate monetary benefits of approximately $4.53 million per year to system users. Table II-7 shows the aggregate time savings from each Red Line Station to downtown Boston.

Travel Cost

In addition to time savings, Red Line users would benefit from reductions in real trip costs. Table II-8 shows estimated 1980 real user costs from Red Line stations to downtown Boston for trips via auto, the existing transit system, and the Red Line Extension. Parking charges at auto destinations and at Red Line stations were not included in the cost computations. If typical parking costs were included, the benefits to diverted auto users would be greater than shown due to the difference between parking fees in the core and at the proposed stations. Based on the savings per trip from Red Line Extension stations, aggregate costs savings resulting from the project would be approximately $6.57 million per year. Table II-9 shows the daily savings for diverted auto users and existing transit users and includes an estimate of parking cost benefits.

Travel Convenience

Trip-makers also tend to heavily penalize transit for time spent waiting and transferring. Comparative disutilities indicate that one minute of waiting time is equivalent to three to four minutes of transit ride time (five to ten minutes of auto ride time) and that one minute of transfer time is equivalent to eight to ten minutes of transit ride time (15 to 30 minutes of auto ride time).

Extension of the Red Line would greatly improve the convenience of transit travel in the Northwest Subregion. Although Red Line service would be on a fixed right-of-way, the frequency of service would be far superior to that presently provided with the bus

Table II-7

AGGREGATE 1980 TRAVEL TIME SAVINGS TO DOWNTOWN BOSTON FROM RED LINE STATIONS*

From	Auto Diversions (a) Trips/ Day	Auto Diversions (a) Hours Saved/ Trip	Transit Users Trips/ Day	Transit Users Hours Saved/ Trip	Time Saved (Person-Hours)
Harvard Square	0	0.157	11,100	0.0	0
Porter Square	1,860	0.147	2,350	0.132	585
Davis Square	2,430	0.120	3,050	0.155	765
Alewife	2,460	0.085	3,100	0.158	700
Arlington Center	1,620	0.062	2,050	0.180	470
Arlington Heights	840	0.073	1,050	0.292	370
Subtotal	9,210		22,700		2,890
Lexington Center	480	0.160	600	0.73	515
Route 128	960	0.182	1,200	0.992	1,365
Total	10,650	--	24,500	--	4,770

* Represents travel time savings occurring with inbound, weekday trips.

(a) Estimated to be 30 percent of ridership; represents 65 percent of new ridership. Remainder of new ridership does not receive travel time benefits.

NOTE: This project terminates at Arlington Heights. The extension from Arlington Heights to Route 128 would be part of a future development.

Table II-8

ESTIMATED 1980 TRAVEL COSTS FROM RED LINE STATIONS TO DOWNTOWN BOSTON

From	Via Auto(a)		Via Transit(b)		Extension User Savings(c)	
	Mileage	Cost	Existing	Red Line	Auto	Existing
Harvard Square	3.5	$0.77	$0.25	$0.25	$0.52	$ 0
Porter Square	4.0	0.88	0.50	0.25	0.63	0.25
Davis Square	4.5	0.99	0.50	0.25	0.74	0.25
Alewife	6.0	1.32	0.50	0.50	0.82	0
Arlington Center	8.0	1.76	0.50	0.50	1.26	0
Arlington Heights	9.0	1.89	0.50	0.50	1.23	(0.25)
Lexington Center	13.0	2.89	0.75	0.75	2.11	0
Route 128	14.5	3.19	0.75	1.00	2.19	(0.25)

(a) Typical route-milage @ $0.22 per mile; does not include parking fee at destination.

(b) Assumes no change in MBTA fare structure or rate; does not include parking fee at stations for park-and-ride users.

(c) (0.00) indicates a disbenefit.

NOTE: This project terminates at Arlington Heights. The extension from Arlington Heights to Route 128 would be part of a future development.

Table II-9

ESTIMATED 1980 AGGREGATE TRAVEL COST SAVINGS
TO DOWNTOWN BOSTON FROM RED LINE STATIONS[a]

From	User Benefit Groups: Auto Division	User Benefit Groups: Existing Transit	Parking Cost[b] Benefits	Total
Harvard Square	$ 0	$ 0	$ 0	$ 0
Porter Square	970	590	1,940	3,500
Davis Square	1,530	760	3,060	5,350
Alewife	1,820	0	580	2,400
Arlington Center	2,040	0	440	2,480
Arlington Heights	1,030	(260)[c]	610	1,380
Subtotal	$ 7,390	$1,090	$ 6,630	$15,110
Lexington Center	1,010	0	160	1,170
Route 128	2,100	(300)[c]	(1,300)[c]	500
Total	$10,500	$790	$5,490	$16,780

(a) Represents cost savings accrued with inbound, weekday trips.

(b) Assumed parking costs: core--$2.00/day; stations--$0.75/day.
Benefits: (auto diversion - station parking capacity) x (2.0 - 0.75)

(c) (000) indicates a disbenefit.

NOTE: This project terminates at Arlington Heights. The extension from Arlington Heights to Route 128 would be part of a future improvement.

system, resulting in reduced average wait times. More significantly, the number of people having to transfer to rapid transit at Harvard Square would be substantially reduced. These persons would instead board the Red Line directly at an extension station closer to their trip origin. Additionally, these persons would not encounter the traffic congestion delays, faced with the present bus system.

Based on existing system headways, it is estimated that savings in wait time with the Red Line Extension would be approximately 2,960 person-hours per day (approximately 770,000 person-hours per year). This represents approximately 30 percent of the total travel time savings. Table II-10 shows the savings for each Red Line Station.

Access

Extension of the Red Line would afford improved access to the core area and extend the benefits of rapid transit service to residents of outlying communities, thereby expanding their employment, commercial and institutional opportunities and reducing travel time and inconvenience. Intraregional travel between intermediate stations would also be enhanced by the improved service.

Based on CTPS demand estimates, the number of new transit users on the Red Line Extension could total 19,100 riders per day (41 percent of the estimated project ridership). Of these riders, 9,210 would be diverted auto users. The remaining 9,890 persons are those who would not travel if the Red Line is not extended. These persons reside in the Northwest Subregion and would benefit from improved access to Boston and Cambridge with a Red Line Extension. Table II-11 shows a breakdown of new transit users by Red Line Station.

An additional access improvement would be the provision of a feasible transit alternative for the reverse commuter--the commuter who travels away from the core in the morning and toward the core in the evening. Due to the nature of peak-period bus operation, the existing transit system is based toward core-bound commuters. With a rapid transit system, however, the availability of transit service for persons traveling in the opposite direction of the major travel flow would be increased.

Table II-10

ESTIMATED 1980 WAIT TIME SAVINGS FOR RED LINE USERS[a]

Station	Average Wait Times (Peak-Hour)[b] Existing System (Minutes)	Red Line	Affected Users	Time Saved (Person-Hours)
Harvard Square	2	2	11,100	0
Porter Square	5.5	2	2,350	140
Davis Square	6.5	2	3,050	230
Alewife	5.8	2	3,100	200
Arlington Center	4.5	2	2,050	90
Arlington Heights	4.5	2	1,050	40
Subtotal			22,700	700
Lexington Center	3.2	2	600	300
Route 128	25.8	2	1,200	480
TOTAL	--	--	24,500	1,480

(a) Represents inbound, weekday savings accruing to existing system users; value is included in travel time savings analysis.

(b) One-half of peak-hour headway; composite bus/rapid transit headways for existing system.

NOTE: This project terminates at Arlington Heights. The extension from Arlington Heights to Route 128 would be part of a future improvement.

Table II-11

ESTIMATED 1980 NEW TRANSIT USERS FROM
RED LINE STATIONS TO DOWNTOWN BOSTON

From	Total Users	Existing Users	New Transit Users	
			Diverted From Auto	New Travelers
Harvard Square	11,100	11,100	0	0
Porter Square	6,200	2,350	1,860	1,990
Davis Square	8,100	3,050	2,430	2,620
Alewife	8,200	3,100	2,460	2,640
Arlington Center	5,400	2,050	1,620	1,730
Arlington Heights	2,800	1,050	840	910
Subtotal	41,800	22,700	9,210	9,890
Lexington Center	1,600	600	480	520
Route 128	3,200	1,200	960	1,040
Total	46,600	24,500	10,650	11,450

NOTE: This project terminates at Arlington Heights. The extension from Arlington Heights to Route 128 would be part of a future improvement.

Although reverse trips do not comprise a large portion of the peak travel volume, such trips are presently limited to the auto mode.

Mobility

In addition to improving accessibility for the general public, the introduction of rapid transit service would increase the travel opportunities for limited-mobility persons in the Northwest Subregion. A low cost, convenient, and fast public transit alternative would provide improved access to core area opportunities for the auto-deficient, economically disadvantaged, and non-driving persons. Additionally, the inclusion of passenger amenities such as elevators and ramps, would increase travel opportunities for the elderly and physically handicapped. See station chapters for details.

In summary, user benefits resulting from the Red Line Extension would include reduced travel times, reduced travel costs, improved convenience, greater access to possible employment commercial and recreational opportunities, and increased mobility for persons who would not otherwise be able to travel. In addition, the extended service would incorporate the most modern design standards and user amenities, thereby improving the user's image of public transit.

Regional Benefits

The Red Line Extension would create areawide benefits that would be shared by all residents of the Northwest Subregion including:

- Reduced vehicular volumes on major arterials and streets in the area.

- Improved access to commercial, employment, and institutional facilities in the Northwest Subregion.

Vehicular Demand

Implementation of rapid transit service in the outlying communities of the Northwest Subregion would afford a sufficiently attractive public transit alternative that would permit approximately 7,675 automobile trips to be diverted to transit.

Following completion of the South Shore Extension, a rider survey indicated that nearly 30 percent of the users had made the trip by auto prior to the initiation of extended service. This indicates that effective transit service can successfully attract auto users.

Estimated 1980 vehicular travel in the Northwest Subregion would be 4,120,000 VMT per day, if existing transit and auto service levels are maintained. The Red Line Extension, to Arlington Heights is expected to result in a daily savings of 110,000 VMT, a reduction of 2.7 percent. An estimated 7,675 daily vehicle trips would be diverted from arterials and streets in the Northwest Subregion and the Boston core.

The overall reduction of automobile use would contribute to improved air quality in the Northwest Subregion by reducing the level of auto emissions. In addition, the lower vehicular demand would improve the efficiency of traffic control efforts, thereby affording higher levels of service for highway users. The elimination of major bus movements--which would be replaced by rapid transit service--would also contribute to improved traffic flow conditions. More efficient traffic flow would, in turn, improve bus service operations.

Due to the configuration of the Northwest highway system and the locations of a limited number of Charles River crossings, much of the core-bound automobile traffic from the Northwest Subregion converges in Cambridge. Cambridge is also a major destination for trips originating in the Northwest Subregion. The central location of Harvard Square directs much of this traffic to the Square itself. Auto trips diverted to the Red Line Extension would reduce traffic volumes on Cambridge streets and highways.

The greatest potential for traffic flow improvements exists at Harvard Square. The high vehicular and pedestrian volumes in that area are largely attributable to the present Red Line terminal location. The attractions of the Cambridge area, together with transfer activities at the Red Line Station, result in severe congestion on the approach streets to Harvard Square. Extension of the Red Line to Alewife or beyond, would eliminate much of the bus-and car-to-transit transfer activity at the Square. It is anticipated that many of the trips which are presently made by

boarding the Red Line at Harvard Square would be intercepted at outlying stations along the extension. The BTPR estimated that there would be 24,500 inbound boardings per day at Harvard Square if the Red Line is not extended; CTPS estimates indicate that the Red Line Extension would result in approximately 11,100 inbound, boardings per day at Harvard Square which would be 55 percent less than with the no-build option. The associated reduction in vehicular access volumes would eliminate much of the existing congestion and improve traffic flow in the area.

Access

Although improved access is a user benefit, it is also beneficial to the region as a whole. Increasing the opportunities for residents of outlying communities to take advantage of services available throughout the region also increases the market for those services. Increased labor and market area accessibility for employers, retailers, and service agencies within the Red Line service area would produce economic benefits for the entire Northwest Subregion, not just for core area establishments. The introduction of new transit stations would strengthen the town centers in which they are located. Also, the capability of the extended system to serve reverse commuters would change the size and shape of market areas for establishments beyond Harvard Square. As stated in the BTPR Study, there were 220,580 work trips per day from the Northwest inner suburbs in 1970. Work trips from the Northwest Subregion to Cambridge accounted for 20 percent of these trips (44,900). Similarly, trips from the Northwest Subregion to Boston proper accounted for only 23 percent of the total (51,800). The BTPR Study also indicated that from 1960 to 1968 Cambridge experienced a 7.2 percent increase in total employment, while Somerville lost employment opportunities during the same period; also 80 percent of the employment in the Northwest outer core (Cambridge and Somerville) was located in Cambridge at that time. In addition, although Cambridge experienced a 12.7 percent decrease in the number of retail establishments between 1963 and 1967, the volume of retail sales increased 11.8 percent. Forty-two percent of the retail establishments in the Northwest outer core and inner suburbs, and 58 percent of the regions higher education opportunities are located in Cambridge. These statistics are indicative of the importance of Cambridge as a trip attractor for persons in the Northwest Subregion. Introduction

of rapid transit service between Cambridge and outlying communities would increase the opportunities available to residents in the outer Northwest area, thereby increasing the effective market areas of the region's establishments.

Operator Benefits

If the Red Line is extended, the benefits experienced by the MBTA would be mainly operational in nature. Such benefits would permit more efficient use of transit resources and would include:

- Lower long-term operating costs.
- More efficient use of the bus fleet.
- Improved terminal facilities.

Lower Long-Term Costs

Although the Red Line Extension project would require an extensive capital investment, over the long run it would be less expensive than bus transit for the level of service that would be provided. The capital-intensive nature of a Red Line Extension would require a large initial investment which would be repaid over time. However, the expansion of bus service--which is highly labor-intensive--to provide a comparable level of service would involve not only a significant amount of initial capital outlay but also continually increasing and extensive labor related expenses. Over the life of the project, this service would prove more expensive than the rapid transit option, which would entail only a minimal labor expense.

Efficient Bus Use

Extension of the Red Line would reduce the number of buses required for long haul service between the Northwest Subregion, Cambridge, and downtown Boston. These buses would then be available to provide more efficient feeder service for improved access to the rapid transit line. In addition to complementing rapid transit service, the expanded feeder network would improve the overall quality of local transit service between points not served by the Red Line and would increase the bus accessibility of intraregional trip attractors.

Terminal Facilities

Locating a new Red Line terminal in the Northwest Subregion would afford the MBTA an opportunity to construct a facility utilizing current state-of-the-art technology, equipment and design standards that would result in more efficient terminal operations. Incorporating plans for optimum user access and circulation conditions, including vehicular access capacity, external vehicular circulation and external/internal pedestrian flows, in the terminal station design would be an additional benefit of a new Red Line terminal.

Governmental Benefits

Additional benefits would be realized by the Northwest Subregion through expanded transportation policy options and potential cost savings which would accrue to the responsible governmental bodies and through them, to their constituencies. These benefits include:

- Expansion of feasible transportation policies
- Future highway cost savings

Transportation Policies

The Environmental Protection Agency (EPA) is establishing auto emission and air quality standards for metropolitan areas throughout the U.S. The Urban Mass Transportation Administration (UMTA) is becoming increasingly concerned with traffic management programs as they relate to transportation projects. The Commonwealth of Massachusetts has formulated a transportation development policy which emphasizes a public transit program. Extension of the Red Line is one outcome of these governmental influences on the expenditure of public monies for transportation. However, as related to transportation policy, creation of a feasible public transit alternative to automobile travel is only one of the benefits of this project. Provision of extended transit service would increase the number and diversity of transportation policies which are practical for implementation.

Regulatory agencies and local governments have been investigating the practicability of auto disincentives, especially in

CBD's. Boston has been under pressure to implement programs such as freezing parking supplies, increasing parking fees through a taxing mechanism; and increasing highway tolls. Such programs are intended to reduce the extent of auto travel in areas where there is a public transit alternative, to help reduce auto emission levels and the increasing costs of traffic control. Some critics of these programs have argued that the area lacks feasible public transit alternatives which could serve the entire trip or which could suitably intercept auto trips outside the CBD. Extension of Red Line service would provide a satisfactory public transit alternative in the Northwest Subregion and, as part of the region's overall transportation program, would thereby make the policy of auto disincentives in the CBD more practicable. The presence of a fixed transit network would also be beneficial if fuel costs continue to increase, either as a result of rising petroleum costs or government-imposed taxes.

With suitable public transit alternatives available, it would be easier to implement auto disincentives in the core area. The extension of the Red Line itself is only one portion of the transit development program that would induce auto diversions. Specific traffic management techniques which can be used as automobile disincentives include a freeze on parking supply, restrictive parking fees and road user pricing. The BTPR Study estimated that a $1.00 increase in CBD parking fees would divert 5.6 percent of the auto trips to the core and would reduce VMT by 1.87 percent in the core and 1.06 percent in the inner suburbs. A report to the EPA, "Transportation Controls to Reduce Motor Vehicle in Boston, Massachusetts", December 1972, stated that implementation of a road-user pricing strategy that would levy a 25 cent charge on all autos entering and leaving the Boston CBD could reduce VMT by 2.8 percent in the core and 0.9 percent in local areas. Although not all diverted motorists would opt for transit, a significant portion would be attracted to the system. The increased utilization of transit would thus result in increased transit revenues.

Future Highways

The history of highway construction in the U.S., since the emergence of the automobile as the dominant travel mode, has been one of continuing investment and expansion. Construction of new highways and/or enlargement of existing highways is an

increasingly costly venture, especially in developed areas, and has consumed large amounts of economic and physical resources. On the basis of cost per passenger mile, highway investment is a less efficient option than transit. The diversion of auto trips, --either voluntary or in response to external negative stimuli--to an extended Red Line would reduce the demand for auto facilities in the Northwest Subregion. Consequential savings in highway construction, expansion, maintenance and traffic control costs could result in substantial net benefits to the region.

Specifically, it is estimated that approximately 7,675 inbound auto trips (9,210 person-trips) would be diverted to the Red Line if it is extended to Arlington Heights. Assuming that a large amount of these would be work trips, it is conceivable that 4,000 trips could occur in the peak hour. Based on the proportion of work trips to Boston and Cambridge, approximately 2,000 vehicle trips could be eliminated from Cambridge and Boston streets during peak hours. In an article entitled "Pricing in Urban and Suburban Transport" (American Economic Review; May 1963), Vickry estimates that the marginal cost of providing additional peak-hour auto capacity is $9.00 per vehicle trip. Clearly, any significant reductions in peak-hour volumes could substantially reduce highway construction and maintenance costs.

Ridership

Based on the revised population forecasts and land use distribution assumptions since the BTPR Study, the CTPS prepared updated demand estimates as shown in Table II-12. Local policy decisions, space limitations, station area street capacities, and other local factors have dictated the amount of parking that would be available at Red Line stations which, in most cases, would be less than the estimated demand. Parking supply constraints would impact Red Line ridership by limiting the park-and-ride access. Table II-13 shows expected station boardings reflecting the constraints imposed by the limited parking supply.

Table II-12

ESTIMATED 1980 DAILY INBOUND DEMAND
AT RED LINE STATIONS

Station	Route 128	Arlington Heights	Alewife	Existing
Harvard Square	11,100	11,100	11,100	24,500
Porter Square	6,400	6,400	6,400	-
Davis Square	9,200	9.200	9,200	-
Alewife	8,500	9,100	14,500	-
Arlington Center	7,000	7,100	-	-
Arlington Heights	3,300	4,700	-	-
Subtotal	45,500	47,600	41,200	24,500
Lexington Center	1,900	-	-	-
Route 128	4,100	-	-	-
Total	51,500	47,600	41,200	24,500

Source: CTPS

NOTE: This project terminates at Arlington Heights. The extension from Arlington Heights to Route 128 would be part of a future improvement.

Table II-13

ESTIMATED 1980 DAILY INBOUND BOARDINGS
AT RED LINE STATIONS WITH LIMITED PARKING SUPPLY

	Alternative Terminals			
Station	Route 128	Arlington Heights	Alewife	Existing
Harvard Square	11,100	11,100	11,100	24,500
Porter Square	6,200	6,200	6,200	-
Davis Square	8,100	8,100	8,100	-
Alewife	8,200	8,300	11,800	-
Arlington Center	5,400	5,400	-	-
Arlington Heights	2,800	3,600	-	-
Subtotal	41,800	42,700	37,200	24,500
Lexington Center	1,600	-	-	-
Route 128	3,200	-	-	-
Total	46,600	42,700	37,200	24,500

Source: CTPS

NOTE: This project terminates at Arlington Heights. The extension from Arlington Heights to Route 128 would be part of a future improvement.

Parking

The anticipated demand/supply relationship would result in an excess parking demand of approximately 5,650 vehicles per day with an Arlington Heights terminal. The parking supply would be limited to 2,350 spaces with a terminal at Arlington Heights. These limits, for testing purposes, are based on City of Cambridge policy statements, the physical and economic characteristics of the station areas, and opinions of the different transportation advisory groups.

Although it is conceivable that the limited supply of parking would cause some of the excess demand to divert to other access modes, such as kiss-and-ride and bus, a portion of the park-and-ride demand can be expected to choose not to use the Red Line if sufficient parking is not provided. Table II-14 shows the estimated diversion of the excess park-and-ride demand to other access modes and the remaining excess demand.

Table II-14

REDISTRIBUTION OF EXCESS PARK-AND-RIDE DEMAND
AT RED LINE STATIONS
(Daily Transit Passengers)

	Alternative Terminals		
	Route 128	Arlington Heights	Alewife
Diverted to other access modes	1,170	1,650	1,090
Remaining excess demand	4,730	5,130	4,030

This potential excess park-and-ride demand would essentially have two options: 1) to choose not to use the Red Line, thus resulting in reduced ridership; or 2) to park-and-ride in spite of parking restrictions and attempt to seek on-street parking spaces. The split between the two options can be estimated only in very general terms. Both options, however, would have a negative effect on the transportation system in the Northwest Corridor. Persons

choosing not to use the Red Line would tend to make their trips by auto, thereby contributing to vehicular congestion on the region's streets. Persons seeking on-street parking would contribute to the congestion in the station areas and would occupy on-street spaces needed by local residents for personal, shopping and business trips. Parking restrictions could be imposed to regulate the usage of available on-street spaces, but enforcement of such restrictions could place heavy manpower and cost burdens on the affected towns and cities.

A comparison of Tables II-12 & II-13, which indicate inbound demand versus constrained daily inbound boardings, shows the impact of the parking supply limits on the total ridership potential of the Red Line Extension. By limiting the parking supply, the estimated ridership for all alternative terminals would be approximately ten percent less than the forecasted demand.

Alternative Terminals

Table II-15 presents the estimated ridership gains which would be experienced with extension of Red Line service beyond Harvard Square. The largest incremental ridership gain (33 percent) would result with an extension to Alewife; extensions to Arlington Heights and Route 128 would result in additional increases of 14 and 10 percent, respectively.

Table II-15

ESTIMATED 1980 RED LINE RIDERSHIP GAINS BY ALTERNATIVE TERMINAL

Alternative Terminal	Estimated 1980 Daily Inbound Boardings	Increase	
		Daily Inbound Boardings	Percent
Harvard Square (a)	38,500	0	0
Alewife	51,200	12,700	33
Arlington Heights	56,700	18,200	47
Route 128	60,600	22,100	57

(a) Includes Harvard Square, Central, and Kendall Stations.

Vehicular Traffic

The estimated traffic volume in the five cities and towns directly affected by the project (Arlington, Belmont, Cambridge, Lexington and Somerville) was 3,940,000 vehicle-miles of travel (VMT) in 1975. This figure is expected to increase to 4,230,000 VMT by 1980 if no major transit improvements are implemented. Table II-16 shows the estimated 1980 vehicular travel in these areas with Red Line Extension to Route 128, Arlington Heights, and Alewife.

Table II-16

ESTIMATED 1980 VEHICULAR TRAVEL NORTHWEST SUBREGION

Transportation Alternative	Estimated Vehicle-Miles of Travel (VMT)/Day	Percent Change From Existing VMT
Maintain existing system	4,230,000	+7.4
Extend Red Line to:		
Alewife	4,150,000	+5.3
Arlington Heights	4,120,000	+4.6
Route 128	4,090,000	+3.8

These estimates assume existing vehicular trends would extend to the future and do not consider the possible effects of automobile disincentives. If significant regional traffic management techniques, such as a freeze on parking supply in the CBD or substantial toll and parking fee increases, are instituted in response to state directives or to meet regional EPA air-quality standards, further reductions in VMT could be expected as a result of increased diversion of auto trips to transit.

The introduction of new rapid transit service would increase the bus and/or automobile traffic on streets in the vicinity of the stations. The project would generate vehicular trips to the station areas by transit passengers arriving via automobile (park-and-ride and kiss-and-ride) and, to a lesser extent, by those arriving via

bus. Generally, these trips would be new vehicle trips on the station approach streets. Table II-17 shows estimated 1980 daily auto arrivals at each station for each alternative.

Table II-17

ESTIMATED 1980 DAILY AUTO ARRIVALS*
AT RED LINE STATIONS

Red Line Station	Alternative Terminals		
	Route 128	Arlington Heights	Alewife
Harvard Square	90	90	90
Porter Square	990	990	990
Davis Square	2,090	2,090	2,090
Alewife	3,480	3,540	4,300
Arlington Center	1,830	1,830	N/A
Arlington Heights	1,300	1,500	N/A
Subtotal	9,780	10,040	7,470
Lexington Center	480	N/A	N/A
Route 128	2,260	N/A	N/A
Total	12,520	10,040	7,470

* Park-and-ride (1.2 transit riders per auto) plus kiss-and-ride (1.2 transit riders per auto).

Source: CTPS

NOTE: This project terminates at Arlington Heights. The extension from Arlington Heights to Route 128 would be part of a future improvement.

Feeder Bus Service

Table II-18 indicates proposed changes to the existing northwest corridor feeder bus service to facilitate optimum feeder bus service to Red Line Extension stations. Figure II-11 shows the specific routings for the existing system and Figure II-12 shows the routings for the proposed feeder Bus system. In all, two new routes--Arlington Center to Newton Corner and Arlington Center to Malden--and modifications to seven existing routes are proposed.

Table II-18

PROPOSED FEEDER BUS SERVICE
WITH RED LINE EXTENSION TO ARLINGTON HEIGHTS

	Existing Service	Proposed Service Route	Proposed Service Headways
Route 528	Hanscom AFB-Harvard Square	Hanscom AFB-Arlington Heights	30 (Peak) 60 (Off-peak)
Route 530	Arlington Center-Lexington (Five Forks)	Arlington Center-Wilmington (via Lexington Center and Burlington Mall	30 60
Route 700	Burlington-Boston	Burlington-Arlington Center	60
Route 518	New Route	Arlington Center-Newton Corner	30 60
Route 81	New Route	Arlington Center-Malden	30 60
Route 78	Arlington Heights-Harvard Square	Arlington Heights-Harvard Square	10 30
Route 84	Arlmont-Harvard via Route 2	Arlington Heights-Alewife (via Gray St.)	10 30
Route 77A	Arlington Heights-Harvard Square (77)	Arlington Heights-	10
		Alewife	15
Route 77B		Arlington Center-Harvard Square	10 15
Route 87	Arlington Center-Lechmere	Arlington Center-Lechmere	10 15

Net assessment impacts for the proposed changes to bus routes were calculated based on ridership revenue and costs. Table II-19 presents projected ridership by route on opening day. Hours of service have been assumed to be expanded to evenings and/or weekends for those routes which do not have such service, in order to develop a maximum service strategy. Ridership was projected using a route specific demand model.

Table II-19

PROJECTED RIDERSHIP AND ANNUAL REVENUE WITH PROPOSED RED LINE EXTENSION FEEDER BUS SERVICE

Route #	Estimated Annual Ridership	Estimated Annual Revenue
528	152,908	53,518
530	328,214	114,874
700	286,112	100,139
518	213,940	47,066
81	134,608	29,613
78	958,868	210,950
84	362,582	79,768
77A	1,432,000	315,040
77B	1,432,000	315,040
87	1,857,570	408,665

The estimated assessments for local service were calculated by multiplying the new or reduced mileage occurring in each community by $3.30 (cost per mile) and then by .17 (estimated percent of assessible cost passed on to the community). The resulting estimated increase or decrease in assessment charges for local service with the proposed Feeder Bus System is given in Table II-20. The 1976 total assessment shown in this table includes express service as well as local service.

Table II-20

PROJECTED ASSESSMENT CHANGES FOR LOCAL SERVICE
WITH PROPOSED RED LINE
FEEDER BUS SERVICE

ASSESSMENT IMPACT[1]

	1976 Assessment	Proposed Local Service Assessment Change	% Change
Arlington	$1,452,152	- $55,000	— 3.8%
Bedford	159,539	17,030	+ 10.6
Belmont	760,315	13,880	+ 18.2
Burlington	283,555	29,114	+ 10.3
Lexington	106,706	8,394	+ 7.9
Malden	1,553,649	5,257	+ .3
Medford	1,809,820	28,105	+ 1.5
Newton	2,445,032	4,161	+ .2
Watertown	991,606	10,777	+ 1.0
Wilmington	202,314	6,138	+ 3.0

[1]Does not include inflation factor.

MBTA Deficit and Assessment

Table II-21 summarizes the current (1976) MBTA deficit and local assessments for Arlington, Cambridge and Somerville. It also shows what the deficit and assessments would be for these communities if the Red Line Extension had been operating in 1976, in which case, deficit and assessment estimates were projected using 1976 operating costs and revenue data and assuming modifications to bus routing in these communities as described in the Feeder Bus Section of this chapter.

TABLE II-21
MBTA ASSESSMENTS FOR ARLINGTON, CAMBRIDGE AND SOMERVILLE WITH AND WITHOUT RED LINE EXTENSION

EXISTING MBTA DEFICIT (1976) (AFTER ADDITIONAL STATE AID)

	Cambridge	Somerville	Arlington
Express Service Deficit			
75% No. of Commuters	$833,258.	$1,040,354.	$682,036.
25% Boardings	1,083,541.	-	331.
Debt Service (MTA)	133,383.	72,394.	47,483.
Sub Totals	$2,050,182.	$1,112,748.	$729,850.
Local Service Deficit			
50% Population	$806,513.	$713,442.	$430,126.
50% Losses Incurred	869,021.	555,200.	283,333.
Sub Totals	$1,675,534.	$1,268,642.	$713,459.
Rapid Transit Subsidy			
50% Population	1,297.	1,147.	$692.
50% Losses Incurred	-	-	-
Sub Totals	1,297.	1,147.	692.
Total (T) Deficit (1976)	$3,727,013.	$2,382,537.	$1,444,001.
Estimated Interest Charged by State Treasurer	465,503.	303,374.	181,977.
Total Estimated Assessment	$4,192,516.	$2,685,911.	$1,625,978.

PROJECTED MBTA DEFICIT 1976 WITH RED LINE EXTENSION

(ASSUMING THE STATE TO PICK-UP 50% OF $3.2M INCREASE)

	Cambridge	Somerville	Arlington
Express Service Deficit			
75% No. of Commuters	$867,303.	$1,082,859.	$709,900.
25% Boardings	835,587.	-	375.
Debt Service (MTA)	133,383.	72,394.	47,483.
Sub Totals	$1,836,273.	$1,155,253.	$757,758.
Local Service Deficit			
50% Population	804,980.	712,087.	429,308.
50% Losses Incurred	667,638.	565,000.	242,881.
Sub Totals	$1,472,618.	$1,277,087.	$672,189.
Rapid Transit Subsidy			
50% Population	1,297.	1,147.	692.
50% Losses Incurred	-	-	-
Sub Totals	$1,297.	$1,147.	$692.
Total (T) Deficit (1976 with 50% of $3.2 M Increase)	$3,310,188.	$2,433,487.	$1,430,639.
Estimated Interest Charged By State Treasurer	414,500.	303,435.	182,000.
Total Estimated 1976 Assessment (with Red Line Extension)	$3,724,688.	$2,736,922.	$1,612,639.

Source: MBTA

Comparing the existing deficit and assessment with those projected for the Red Line Extension shows the estimated impact that Red Line Extension operation might have on Arlington's, Cambridge's and Somerville's MBTA assessment. Under the conditions set for these projections, both Arlington and Cambridge would experience a decrease in local assessment and Somerville would show a slight increase.

Existing Rail Service

Freight Cutoff

The existing railroad line is a single track connecting the Fitchburg Main Line, in the vicinity of Alewife Brook, to the New Hampshire Main Line in Somerville. The line crosses the Lexington Branch at grade in the Alewife Brook Area. There are no other at grade rail crossings. Of the several highway grade crossings, the major ones are the Massachusetts Avenue/Cameron Avenue and College Avenue/Holland Street complexes.

Several industrial and team track sidings are located along the line, many of which are not currently being used. Local freight service is provided from the Fitchburg or west end of the line for all customers except one. Elhide Warehouse is served from the New Hampshire Main Line on the east end. (See Figure II-5.)

Under current Boston and Maine operating procedure, inbound and outbound freight trains (two trains a day in each direction) use the Freight Cutoff for access, to and from Yard No. 8, a hump yard, located adjacent to the New Hampshire Main Line. There is no direct access to Yard 8 from the Fitchburg Main Line.

There is no MBTA Commuter Rail service over the Freight Cutoff.

Lexington Branch

The existing Lexington Branch line is a single track that extends between the Fitchburg Main Line in North Cambridge and Bedford. The line crosses the Freight Cutoff at grade in the Alewife Brook area. The most heavily used highway grade crossing is Massachusetts Avenue in Arlington Center.

There are several industrial and team track sidings along the line, many of which are not currently being used. (See Figure II-5.) Hanscom Air Force Base is adjacent to the line in Bedford, and its only rail access is by way of the Lexington Branch. Local freight service is provided by a crew operating out of Yard 21 in Boston. The principal customers served on the branch are either in

Alewife Brook or in Arlington. The number of carloads originated and terminated beyond Arlington is so low that the line was considered potentially excess in the 1974 report of the Secretary of Transportation, entitled, "Rail Service in the Midwest and the Northeast Region."

There was one passenger train per day in each direction between Bedford and North Station, Boston. This was discontinued during the March of 1977. The train was a single Budd car which was stored in Bedford every evening. In January 1975, one-way ridership was 60 persons a day. Passenger stations (stops) were located at: Lake Street, Arlington, East Lexington, Pierce's Bridge, Munroe, Lexington, North Lexington and Bedford. There were no passenger facilities other than paved walkways at these stops. Passengers walked or drove to the stops. No feeder bus service was provided. Connection to existing rapid transit was provided only at Boston's North Station.

The condition of the track has deteriorated as a result of deferred maintenance by the Boston and Maine. The track is laid with light rail sections on cinder ballast. The ties are generally bad. Maximum speed is 20 mph, with curves restricted to five to ten mph.

There is no through freight service on the Lexington Branch.

Project Impacts

Freight Cutoff

The MBTA and B & M have recently consummated a purchase and sale agreement with the acquisition of Boston and Maine Railroad assets by the MBTA for $39,500,000. The assets generally include all rail lines and assets located within the MBTA operating territory with the exception of Yard 8 in Boston, the Mystic Dock area, the rail welding plant in Billerica and the auto unloading facility in Ayer. The B & M Budd RDC car fleet is included in the assets. The Purchase and Sale Agreement specifies that the MBTA will "make available to the B & M rail access to its present freight service locations, so long as there are shippers or receivers actively using, or reasonably in prospect to use, such locations." Furthermore, the MBTA will "provide clearances on each route which are equal to current existing physical minimums; however, when a line is eliminated by Authority action, an alternate route of equal clearance, and with equal bridge capacity must be provided at Authority expense."

The MBTA has agreed to provide an equivalent 17'-0" published vertical clearance on the New Hampshire Mainline track from Lowell to Somerville. This is in conformance with current B & M plans. This will provide for the present through freight service on the Freight Cutoff.

To provide the 17'-0" vertical clearance on the New Hampshire Division Line which runs from Lowell to Boston, it is necessary to obtain additional clearance at about 19 bridges. This appears to be feasible by lowering the existing tracks from 6 to 12 inches at most bridges. The work will be accomplished within MBTA right-of-way. This eliminates the need for land takings, surface traffic disruption and other adverse impact. Rail service will be maintained during the track lowering by providing alternate single track operation.

The following are bridges identified for track lowering on the New Hampshire Line:

Lowell Street	Somerville
Cedar Street	Somerville
College Avenue	Somerville
Winthrop Street	Medford
North Street	Medford
Grove Street	Medford
Montvale Avenue	Woburn
New Boston Street	Woburn
Eames Street	Wilmington
Main Street	Wilmington
Butters Row	Wilmington
Route 62	Wilmington
Salem Street	Billerica
Andover Street	Billerica
Gray Street	Billerica
High Street	Billerica
Poor Farm Lane	Billerica

There are two other bridges where the required clearance may be obtained by raising the superstructure. At Shawsheen Avenue, Wilmington, the structure can be raised by 15 inches to maintain a pedestrian only bridge. The privately owned bridge at the Corenco Plant Road in Tewksbury can be raised by about 10 inches.

Local freight service will be maintained to existing customers from each end of the line, and by the relocation of existing team track facilities. Elimination of trackage from a point east of Alewife Brook Parkway to a point east of Grove Street would also eliminate the major at-grade crossing at Davis Square and at the Massachusetts Avenue/Cameron Avenue complex as well as at Grove Street. Implementation of the program with the cooperation of the Boston and Maine would not be considered an abandonment and thus would not require approval of the ICC, as long as rail service to existing customers was maintained.

Existing sidings on the Freight Cutoff are located between Massachusetts Avenue and Grove Street to serve:

1. The Comfort Pillow and Feather Company

2. North Cambridge Warehouse

3. Cameron Avenue Team Track

Cars are not presently received at the first and second sidings. Team track deliveries are made on a fairly regular basis for the following firms:

1. Comfort Pillow and Feather Company

2. New England Kennel

3. Dudley Furniture

This service will be provided from a team track in the West Cambridge Yard and a team track east of Grove Street.

Although current carloads handled to these customers are not known, the 1974 report of the Department of Transportation indicated that a total of 1,131 carloads were handled by the North Cambridge Freight station in 1972. A large percentage of these were for Dewey-Almy and Bethlehem Steel. It is anticipated therefore that the number of trucks required to transfer the shipments would not substantially add to the present volume of traffic on local streets. The improvements in traffic flow resulting from the elimination of at-grade crossings should offset the effects of the increased truck traffic.

It is proposed that the Freight Cutoff will be abandoned prior to the start of tunnel/cut-and-cover construction. Should this not be timely, through and local freight service can be maintained by shifting the tracks to coincide with tunnel construction.

The above description of impacts would apply to all Red Line alternatives considered, which include the Davis Square Station.

Lexington Branch

Regardless of whether the Red Line Extension were terminated at Arlington Heights or at Route 128 the impact on Lexington Branch train operations would be the same.

According to the BPTR Red Book the following firms were dependent on rail freight service as their major source of supply:

- New England Farms, Arlington*-- "100 employees, 25 cars/week. Receives food in refrigerator cars from West Coast."

*New England Farms was vacated in 1976. The description remains in text due to the possibility of a similar business occupying the facility.

Interviewed in March 1975, a representative of New England Farms estimated present service to be roughly 600 bulk carloads of agricultural products per year. Special automatic unloading equipment has been installed for some commodities, such as potatoes and onions. Employment at the plant varies from 75 to 85 persons during peak spring and summer months to about 55 during the remainder of the year. The representative felt that sheer volume and cost would preclude use of a team track facility. The substitution of piggyback service would require either the purchase or leasing of refrigerated trucks by New England Farms. This would result in higher overall shipping costs.

- Larson Terminal, Arlington -- "8 employees, 6 cars/week, Wholesale lumber dealer."

In a spring 1975 interview, a representative of Larson Terminal said that the company would definitely have to relocate if rail service were discontinued. Approximately 80 percent of the firm's business relies on rail. The company receives from 250 to 300 carloads per year. Seven persons are currently employed. Cars for Arlington Coal and Lumber Co. are also received at the Larson's siding. Cars from Larson's are also occasionally received at the Arlington Team Track.

- Griffith Ladder Company, Bedford -- "100 employees, 1 car/week. Wood required for making ladders comes only from West. Rail only feasible method of supply. Owner says he will go out of business rather than move."

- Malcolm Stevens, Inc., Arlington -- "10 employees, 2 cars/week. Deals in wholesale cast metal products."

Contacted in March 1975, Mr. Stevens repeated his statement that he would have to relocate or go out of business if freight service were discontinued. Products received include bentonite from Wyoming and Alabama, resin coated sand from Illinois, seacoal from Pennsylvania, steinex (silicate of soda) from Iowa and insulated riser sleeves from Johns-Manville of New Jersey. These bulk materials are generally not suitable either for piggyback service or for transshipment from a team track location.

In the BTPR report, rail service was held to be important but not necessarily critical for the following firms:

- Brigham's Ice Cream Company, Arlington -- "1 car/week. Raw materials for food products arrive on rail. A new warehouse has been built specially for rail service."

Contacted in March 1975, Brigham representatives indicated that during the season liquid sugar is purchased, tank cars are received about every two weeks, and that strawberries are shipped in twice a year. It was stated that about $3,600 per year in additional shipping charges would be required if trucks were used for sugar delivery. The firm would have to rely on a commercial carrier and local suppliers since team track shipment would not be feasible during winter months. The strawberries are presently received at the Arlington team track, and could be received at a team track elsewhere. Paper goods for Packaging Distributors, Cambridge, are shipped to Brigham's and unloaded at the team track. Elimination of the siding would create additional shipping costs for that firm also.

- Arlington Coal & Lumber Co., Arlington -- "0-2 cars/month. Primarily a rail user now. Owner not sure if relocation will be needed or not if line abandoned."

Contacted in March 1975, a representative of Arlington Coal & Lumber Co. stated that from 40 to 100 carloads of dimension lumber were received annually, and one carload of plywood was received weekly. Almost all materials shipped by rail are received through

Larson Terminal. If rail service were terminated, supplies could be trucked in from Waltham. It was felt that the firm could survive, but that the additional charges would increase their costs from $6.00 to $7.25 per 1,000 board feet.

- Lexington Lumber Corp., Lexington -- "2 cars/month. Much of the lumber shipped from West. Abandoned rail will mean relying on higher priced wood from the East."

Interviews with Boston and Maine officials early in 1975 indicated that the volume of shipping beyond Arlington is not substantial. The most recent traffic check covered a 12-month period in 1972 and 1973. The exact number of carloads was not revealed, but the low volume is confirmed by the fact that neither the Lexington nor the Bedford station was listed in the Department of Transportation 1974 rail service report. This indicates that fewer than 75 carloads were originated and terminated at those stations. Included in the Bedford total were 32 carloads to and from Hanscom Air Force Base. The base no longer requires rail service on a regular basis.

Customers receiving team track service in Lexington include:

- Gold Ribbon Farms (celery)
- Wilson Farms
- Seasons Four
- L. E. Page (peat moss)

An occasional customer receiving cars at the Arlington team track is the Atlantic Roofing and Skylight Works. This firm indicated in 1972 that "discontinuance of rail service would not have an important impact."

Thus it is estimated that abandonment of rail freight service on the Lexington Branch would result in the following minimum relocations:

Firms	Employees
3	120

A clause in the Purchase and Sale Agreement stipulates that "in the event that the Authority notifies the Railroad that it wishes exclusive use of a line...the Railroad has to obtain requisite governmental or regulatory approval...and use its best efforts to obtain such approval immediately upon the Authority's request". As presently structured, abandonment of rail freight service will require approval of the Interstate Commerce Commission. The Agreement further states that the MBTA will pay the B & M "economic damages"--defined as substantially "the difference between B & M's out-of-pocket cost and B & M's revenue, attributable to the discontinued service, in the last complete calendar year prior to such discontinuance, multiplied by ten--if an Authority dictated change causes the B & M to discontinue service to a revenue-producing customer". Provision for either relocation or alternate rail service for the affected rail customers prior to the filing of the abandonment application would minimize "requirements of public convenience and necessity".

Emergency rail freight access to Hanscom Air Force Base could be provided through the reinstallation of trackage on the abandoned Boston and Maine right-of-way between North Billerica and Bedford. This would require construction of about seven miles of roadbed, and reacquisition of right-of-way sold by the B & M after the line was abandoned. Reinstallation of trackage would cost an estimated $2,000,000 (1975 Dollars) and require the installation of an at-grade crossing across Route 3.

The alternate of providing rail access to Hanscom Air Force Base through enlargement of rapid transit right-of-way and structures also requires the abandonment of rail service and the discontinuation of rail passenger service. It would, therefore, have similar impacts on all rail freight customers as the alternative project.

A second alternative of maintaining rail service at grade during and after construction was also investigated. Commuter rail service may be maintained during the construction phase, but would be discontinued and replaced by the Red Line Extension upon inception of service.

Rail freight service during the construction phase may be temporarily interrupted to certain customers, but provision for alternate service should minimize the effects.

At Alewife Brook, service to Bethlehem Steel could be maintained from the Fitchburg Main Line both during and after Red Line construction. The Lexington Branch beyond Bethlehem Steel, including the at-grade crossing with the Freight Cutoff, could be removed upon approval by the ICC of an abandonment application.

Commuter Service Interface

Transfer facilities at Porter Square between the Red Line Extension and Fitchburg Division commuter trains would facilitate access to Harvard Square and downtown Boston for MBTA Commuter rail riders. This interface between the two modes would be greatly enhanced by the proposed Porter Square station discussed in Chapter IV of this report.

Porter Square Alignment Alternative

Existing Rail Service

The Fitchburg Division is a double track main line. In the vicinity of Porter Square, freight side tracks are located adjacent to each main track. The Fitchburg Main Line is a principal commuter rail route. Both Lexington Branch and Fitchburg Division trains use the line for the access to and from North Station. A passenger station is located at Porter Square in a deep cut below Massachusetts Avenue. Presently, through freight trains do not operate over the line. Local industrial switchers use the line both to serve customers and for access to freight yards in Somerville and North Cambridge.

Impact on Fitchburg Division

Construction in tunnel/deep bore under the Fitchburg Division right-of-way from Porter Square to a station at Alewife would not adversely affect commuter and rail freight service. It appears that the construction of a haul road on the northerly side of the right-of-way would not interfere with normal train operations. According to BTPR analyses, two main line tracks and one siding rack would be maintained on the railroad during construction and after completion of the subway tunnel at Porter Square.

ECONOMIC AND DEMOGRAPHIC FACTORS

Population Characteristics--Existing Conditions

The Boston SMSA (Standard Metropolitan Statistical Area) population increased by about six percent during the 1960-1970 period for an average yearly rate of 0.6 percent. Despite this relatively slow growth rate, the Boston Metropolitan Area is among the fastest growing urban region in New England.

The Northwest Subregion--an area of 20 communities generally between the Massachusetts Turnpike and Route I-93 had a 1970 population of 676,472 persons, or about 25 percent of the Boston SMSA. As the Subregion had grown 9.3 percent in population during the decade, compared with 6.1 percent for the SMSA as a whole, it absorbed the greater share of the regional growth.

In the BTPR Study, the Northwest Subregion was divided into three sections: the core, consisting of Cambridge and Somerville; the inner ring communities within State Route 128; and the outer ring of suburbs on the perimeter of Route 128. Population in the core cities decreased approximately seven percent during the 1960-1970 decade; the cities and towns in the inner ring increased by about the same amount; and the outer ring communities grew at a rate of almost 50 percent. This reflects the national trend of population movement out of urban centers to the suburbs.

Table II-21 shows that Cambridge and Somerville have been losing population since 1960, and the CTPS projections indicate this trend will continue through the next 10 years. Arlington, in contrast, has been experiencing a slow, consistent growth which is projected to continue for the next few decades.

Age Distribution

The Town of Arlington had a somewhat higher percentage of elderly than other communities in the SMSA. Table II-23 illustrates that people 65 and over comprised 14 percent of Arlington's total population; in Cambridge and Somerville, however, they accounted for less than 12 percent. Persons 65 and over generally have fewer cars than other age groups and, therefore, are more dependent on public transit.

Table II-22

POPULATION GROWTH IN THE NORTHWEST SUBREGION 1960-1970

	1960	1970	% Change	Net Migration
Core Cities:				
Cambridge	107,716	100,361	-6.8	-14,651
Somerville	94,697	88,779	-6.2	-16,104
Subtotal	202,413	189,140	-6.6	-30,755
Inner Suburbs (Within Route 128):				
Arlington	49,953	53,354	7.1	-252
Belmont	28,715	28,285	-1.5	-1,590
Lexington	27,691	31,886	15.1	+1,797
Medford	64,971	64,397	-0.9	-5,155
Waltham	55,413	61,582	11.1	-1,127
Watertown	39,092	39,307	0.5	-4,668
Winchester	19,376	22,269	14.9	+1,490
Woburn	31,214	37,406	19.8	+550
Subtotal	316,425	388,486	7.0	-8,995
Outer Suburbs (Beyond Route 128):				
Bedford	10,969	13,513	23.2	+186
Billerica	17,867	31,648	77.1	+8,920
Burlington	12,852	21,980	71.0	+5,046
Carlisle	1,488	2,871	92.9	+1,108
Concord	12,517	16,148	29.0	+2,464
Lincoln	5,613	7,567	34.8	+1,624
Sudbury	7,447	13,506	81.4	+4,395
Wayland	10,444	13,461	28.9	+1,656
Weston	8,261	10,870	31.6	+2,179
Wilmington	12,475	17,102	37.1	+2,260
Subtotal	99,933	148,666	48.8	+29,838
GRAND TOTAL	618,771	676,472	+9.3	-9,872
Boston SMSA	2,595,481	2,753,700	+6.1	-68,522

Source: U.S. Census of Population, 1960 and 1970

Table II-23

1970 POPULATION CHARACTERISTICS: STUDY MUNICIPALITIES

	Total	Sex Distribution %Male	Sex Distribution %Female	Age Distribution 4 and Under	Age Distribution 5-19	Age Distribution 20-64	Age Distribution 65 and Over	Race %Black	Density Per Square Mile
Arlington	53,524	48.2	53.7	3,880	13,178	28,955	7,511	.3	10,253
Cambridge	100,361	48.9	51.1	5,919	20,465	62,277	11,700	6.8	16,187
Somerville	88,779	46.9	53.1	7,538	22,236	63,720	10,788	.8	21,653

Source: U. S. Census of Population, 1970
Block and Tract

Racial Composition

In 1970, the black population in the Northwest Subregion was less than three percent. Of the total segment, over one-half lived in Cambridge and represented 6.8 percent of that City's population. Somerville and Arlington, on the other hand, each had less than one percent black population--0.8 percent and 0.3 percent respectively.

The BTPR found that:

> "A comparison between the 1960 and 1970 Census data shows a perceptible out-movement of the non-white population."

Moreover, it was noted in the BTPR Study many new employment opportunities were developing in the outer suburbs and the Red Line Extension could serve to link people and jobs.

Density

Cambridge and Somerville are among the most densely populated communities in the nation. Cambridge had a 1970 density of 16,187 people per square mile; Somerville had a density of 21,653. Arlington was less densely populated with 10,258 people per square mile, which was below the City of Boston's 13,936. For the Boston Metropolitan Area, SMSA density was only 2,791 persons per square mile.

In contrast, the population density for the cities of Washington, D.C., Chicago and Philadelphia was 12,321; 15,136 and 15,175 persons per square mile respectively. The SMSA for those central cities had densities of 5,781; 5,464 and 6,413 persons per square mile, respectively. While Boston and its metropolitan region had densities that were generally below these three major urban areas, the cities of Cambridge and Somerville had higher densities.

Income Characteristics

Table II-24 shows that the communities in the Northwest Subregion reported median incomes higher than the metropolitan region as a whole. Due to the concentration of students and "blue-collar" workers, the core cities of Cambridge and Somerville had families with lower average incomes.

Table II-24

1970 INCOME CHARACTERISTICS: STUDY MUNICIPALITIES

	Families					Unrelated Individuals	
				Below Poverty Level		Below Poverty Level	
	Total	Median Income	% Change 1960-1970	Total	Percent	Total	Percent
Arlington	14,050	12,247[1]	40.1[2]	587	4.1	830	19.8
Cambridge	20,850	9,815	26.4	1,805	8.6	6,926	28.8
Somerville	22,176	9,594	21.5	1,661	7.5	2,685	30.0

1 1969 Figure

2 Change 1959-1969

Source: U. S. Census of Population,
1970 Block and Tract

Arlington, Massachusetts Comprehensive Plan Report
Economic Summary, Population

The Boston SMSA placed 6.1 percent of all families and 28.8 percent of unrelated individuals, not including students, below the poverty level in 1970. During the same time, the Northwest Subregion, with 4.9 percent of the families below poverty level,* had approximately the same percentage of unrelated individuals, 28.1 percent.

The core cities, with 8.6 percent for Cambridge and 7.5 percent for Somerville, had a slightly higher percentage of families. Cambridge reflected about the same percentage (28.8) of unrelated individuals as the Boston SMSA while Somerville was somewhat higher, with 30.0 percent below poverty level.

Arlington, on the other hand, was lower than the Northwest Subregion in both groups. There were 4.1 percent of all families and 19.8 percent of all unrelated individuals below the poverty level.

* The below poverty level index of the U.S. Census is based on family size and number of children as well as the amount of income.

Employment

The Boston SMSA manufacturing employment has declined 12 percent between 1967 and 1971. Thus, the non-product oriented sectors of the economy accounted for the 3.6 percent employment growth for the metropolitan area during the 1967-1971 period and declines in manufacturing contributed to the high unemployment rates.

Generally, the Northwest Subregion has followed the regional trends in economic maturation; however, the following points from BTPR should be noted:

- "The Northwest Subregion has grown faster in population and employment than the Boston SMSA as a whole; this trend is expected to continue.

- The Northwest has experienced a very pronounced decentralization of population and employment from the core cities and inner suburbs toward the outer suburbs. This was largely the result of expansion of employment activity in the Route 128 belt. However, Cambridge remained the most significant employer in the Northwest Subregion. Its total employment has increased despite a decrease in manufacturing jobs.

- Despite its decline in share of total empoyment, manufacturing remained the dominant economic base of the Northwest Subregion, and represented a greater share of total employment there than in the SMSA as a whole.

- The dominant manufacturing activities in the northwest are in electrical machinery, professional-scientific instruments and optical goods, food and kindred products, and rubber products. The northwest had over one-half the jobs in the metropolitan area in electrical machinery manufacturing--the dominant industry in Boston SMSA and New England. This industry is sensitive to national and international defense expenditures and consequently

has experienced recent employment cutbacks which have had serious economic implications in local communities. The uncertain future of this industry and the slow growth of several of the others suggests these communities may continue to experience greater shift to a service economy.

- Nevertheless the Northwest Subregion enjoys superior locational advantages and access to the regional transport system, as well as proximity to the educational centers. Consequently, to the extent that manufacturing and support activities remain viable and expand in the metropolitan area, the Northwest communities should experience a continued or increasing share of the total.

The Northwest Subregion grew in employment opportunity during the past decade. Growth was not evenly distributed among the communities, however; the outer suburbs more than doubled the total number of jobs available while in the core cities, this factor increased only modestly, with Somerville actually declining by 4.4 percent. The inner suburbs grew 21 percent, as shown in Table II-25

Service-related jobs dominated Cambridge employment with 45.7 percent of all employment in that area; there were smaller concentrations in manufacturing, 21.4 percent, and the retail-wholesale markets with 16.8 percent. The service category of employment is highly concentrated in Cambridge, with over one-half of the total number of Northwest Subregion enterprises engaged in this type of activity located in this community. Over one-half of these furnish educational services, and 20 percent supply business services.

Somerville experienced concentrations in manufacturing, which employed 22.5 percent of the City's labor force, and the retail-wholesale market, which employed 35.6 percent; however, it did not experience Cambridge's dominance of services as only 14.6 percent of the workers were employed in this type of activity.

In Arlington, the employment pattern displayed a concentration of 37.3 percent in retail-wholesale. Services represent the second largest employment source with 21.9 percent of the total employment. The employment opportunities, as a whole, have exhibited an increase of 22 percent in the past decade in Arlington. See Table II-26 for 1970 figures.

Table II-25

GROWTH OF COVERED EMPLOYMENT: NORTHWEST SUBREGION 1960-1968

	1960		1968		Change
	Manufacturing	Total	Manufacturing	Total	Total
CORE					
CAMBRIDGE	24,496	61,196	24,253	65,592	+ 7.2
SOMERVILLE	5,245	18,030	4,330	17,230	- 4.4
Core SUB-TOTAL	30,741	79,326	28,583	82,830	+ 4.4
INNER SUBURBS					
ARLINGTON	353	3,455	443	4,217	+ 22.0
BELMONT	215	2,564	796	3,300	+ 28.3
LEXINGTON	198	2,313	732	5,479	+137.7
MEDFORD	2,390	9,006	2,593	10,792	+ 19.8
WALTHAM	20,998	32,058	20,473	36,150	+ 12.7
WATERTOWN	9,831	15,128	7,794	15,750	+ 4.1
WINCHESTER	684	2,210	840	2,724	+ 23.4
WOBURN	3,444	5,591	4,225	9,300	+ 66.2
SUB-TOTAL	38,113	72,325	37,396	87,712	+ 21.4
OUTER SUBURBS					
BEDFORD	2,512	3,185	6,330	9,392	+194.0
BILLERICA	808	1,818	916	2,634	+ 44.9
BURLINGTON	2,801*	3,715	3,610	12,057	+225.5
CARLISLE	20*	100*	35	168	+ 37.3
CONCORD	1,246	3,132	1,482	4,288	+ 23.0
LINCOLN	1	730	1	276	
SUDBURY	1,185	1,572	1,869	3,036	+ 91.5
WAYLAND	2,675	3,222	2,802	4,122	+ 28.1
WESTON	96	549	54	1,361	+162.4
WILMINGTON	516	3,590	2,126	6,640	+ 84.7
SUB TOTAL	11,860	21,113	19,225	43,974	+108.3
TOTAL	80,714	172,764	85,204	214,516	+ 24.2

* Estimate

Source: Massachusetts Division of Employment Security

Table II-26

1970 EMPLOYMENT DISTRIBUTION--PERCENTAGE
BY WORK CATEGORIES: STUDY MUNCIPALITIES

	Total Number	Manu-facturing	Wholesale/ Retail	Services	Construc-tion	Trans. Comm. Utilities	Finance	Gov't	Unemployed
Arlington	4,071	10.0	37.3	21.9	15.7	4.7	6.8	NA	2.7
Cambridge	78,159	21.4	16.8	45.4	4.0	21.4	2.4	5.7	4.8
Somerville	19,236	22.5	35.6	14.6	5.9	22.5	2.0	10.6	4.4

Source: U. S. Census of Population,
1970 Block and Tract

Arlington, Massachusetts Comprehensive Plan Report
Economy

This table indicates the difference between core and suburban growth in employment opportunity, especially for manufacturing. In Somerville, jobs in manufacturing and total overall employment have declined. Cambridge has gained slightly in employment opportunity while Arlington and the other inner ring suburbs have experienced the greatest gains in employment.

Distribution of Employment

BTPR found that:

> Employment in the Boston Metropolitan area and in the Northwest Subregion is concentrated in the core cities and inner suburbs. This includes principal concentration in the Boston central business district, its frame area and the adjacent communities of Cambridge, Somerville, Everett and Chelsea which comprise the regional core. The second principal area of concentration is among those communities along Route 128 in the Northwest Region extending from Interstate 93 to the Massachusetts Turnpike... Communities beyond Route 128 are still primarily bedroom communities whose employment activities tend to be concentrated in retail trade and service activities with only limited manufacturing... Improved transit and transportation could be catalyst for altering this pattern and precipitating the goal of a more balanced regional growth. However, change in other policies such as zoning, taxation, urban renewal, would also have to be implemented."

Unemployment

In 1970, 3.4 percent of the Northwest Subregion's labor force was unemployed: 3.3 percent of the male work force and 3.5 percent of the female, as shown in Table II-27. Cambridge and Somerville were both above this figure with 4.0 percent and 4.4 percent, repsectively. Cambridge figures were even for male and female; Somerville had a higher percentage of unemployed females, 4.6 percent, than males, 4.2 percent. Arlington was below the total Northwest Subregion level, with only 2.7 percent of its labor force unemployed; the unemployment figure for females was somewhat higher than for males with 3.1 percent and 2.5 percent, respectively.

The unemployment rate has increased throughout the nation. Although more recent figures are not available for the individual communities of the Northwest Subregion, those for the Commonwealth and the Boston SMSA may serve to indicate the growth of unemployment in the region as a whole.

Unemployment in Massachusetts had risen to 10.0 percent in January 1975. The Boston SMSA was slightly below that rate at 9.1 percent. In January 1974, the unemployment rate for the SMSA was 7.8 percent. In one year, therefore, unemployment grew 1.3 percent.

The Northwest communities in 1970 were generally around 3.5 percent which was below the State's rate of 4.6 percent. Since then, the unemployment rate for Massachusetts has risen to 10.0 percent.

Housing

In the 1960-1970 decade, population increased significantly in this subregion. Accordingly, there was an increase in available housing units; Table II-28 shows this increase to be 15 percent. The population trends are also reflected in the distribution of new housing units in the subregion. The core cities had a slight increase in units, with Cambridge gaining six percent and Somerville losing two percent. While the inner suburbs gained 16 percent, Arlington showed an increase of 19 percent. The outer suburbs increased substantially with 42 percent new housing units.

Table II-27

NORTHWEST COMMUNITIES: UNEMPLOYMENT

NORTHWEST COMMUNITIES: UNEMPLOYMENT

	Labor Force: Male			Labor Force: Female		
Core	Total	Unemployed	per cent	Total	Unemployed	per cent
Cambridge	26,361	1,065	4.0	22,622	894	4.0
Somerville	22,774	961	4.2	16,317	749	4.6
Sub-Total	49,135	2,026	4.1	38,939	1,643	4.2
Inner Suburbs						
Arlington	13,981	348	2.5	9,938	305	3.1
Belmont	7,379	168	2.3	5,126	143	2.8
Lexington	8,292	190	2.3	4,662	129	2.8
Medford	16,656	556	3.3	11,090	315	2.8
Waltham	16,240	530	3.3	11,413	307	2.7
Watertown	10,435	336	3.2	7,673	318	4.1
Winchester	5,713	124	2.2	3,397	145	4.3
Woburn	9,867	325	3.3	6,153	203	3.3
Sub-Total	88,563	2,577	2.9	59,452	1,865	3.1
Outer Suburbs						
Bedford	3,004	76	2.5	1,713	38	2.2
Billerica	7,654	268	3.5	3,982	161	4.0
Burlington	5,494	184	3.3	2,746	56	2.0
Carlisle	723	12	1.7	354	8	2.3
Concord	3,785	141	3.7	2,266	59	2.6
Lincoln	1,442	21	1.5	747	9	1.2
Sudbury	3,351	70	2.1	1,612	67	4.2
Wayland	3,502	81	2.3	1,745	47	2.7
Weston	2,679	42	1.6	1,488	47	3.2
Wilmington	4,336	168	3.9	2,246	85	3.8
Sub-Total	35,970	1,063	3.0	18,899	577	3.1
TOTAL	173,668.	5,666	3.3	117,290	4,085	3.5

Source: U.S. Census, 4th Count, 1970

Table II-28

HOUSING CHARACTERISTICS: NW COMMUNITIES

Core	1960 Units	1970 Units	%Change	%Multi-Family 1960	%Multi-Family 1970
Cambridge	35,330	37,349	6	87	89
Somerville	29,219	28,753	-2	88	90
Subtotal	64,549	67,102	4	87	88
Inner Suburbs					
Arlington	15,080	17,921	19	43	56
Belmont	8,776	9,460	8	40	52
Lexington	7,183	8,853	23	3	9
Medford	18,756	19,858	6	55	61
Waltham	15,041	18,560	23	42	59
Watertown	11,590	12,837	11	59	74
Winchester	5,493	6,540	19	12	25
Woburn	8,554	10,794	26	26	38
Subtotal	90,473	104,823	16	40	51
Outer Suburbs					
Bedford	2,359	3,327	41	19	21
Billerica	5,435	8,184	51	4	12
Burlington	3,376	5,423	61	1	6
Carlisle	382	787	106	-	6
Concord	3,500	4,444	27	13	18
Lincoln	1,466	1,914	31	3	30(1)
Sudbury	2,054	3,394	65	2	3
Wayland	2,939	3,669	25	2	5
Weston	2,111	2,785	32	1	4
Wilmington	3,441	4,429	29	4	5
Subtotal	27,063	38,356	42	5	12
Total	182,085	210,281	15	52	56

(1)Includes Air Force Family Housing at Hanscom Field

Table II-29

1970 HOUSING CHARACTERISTICS

	Total Occupied Units	Owner Occupied			Renter Occupied		Population In Group Qtrs	Persons Per Household
		Total	%	Median Value	Total	Average Monthly Rent		
Arlington[1]	17,548	10,075	57.3	25,800	7,227	143	282	3.0
Cambridge	36,411	6,990	19.2	24,200	29,421	119	11,859	2.43
Somerville	28,999	9,884	34.1	16,700	19,115	97	1,799	3.00

Source: U. S. Census of Population,
1970 Block and Tract

Housing Survey, Arlington, Massachusetts August 1973.

1 Arlington figures are from Housing Survey. The 1970 Population as reported in the 1970 Census was 17,921.

Between 1960 and 1970, the percentage of multi-family units in the Northwest Subregion showed a slight increase of four percent, for a total of 56 percent. As seen in Table II-28, the core cities, showing little change from 1960, were above the subregion totals with about 90 percent multi-family dwelling units. The Town of Arlington, slightly above the average for the inner suburbs, increased its percentage of multi-family units from 43 percent in 1960 to 56 percent in 1970. The inner suburbs as a whole increased from 40 percent to 51 percent. With an increase from 5 percent in 1960 to 12 percent in 1970, the outer suburbs had the smallest number of multi-family housing units.

Owner-occupied units

Table II-29 shows that the total of 36,411 occupied units in Cambridge, 6,990, or 19.2 percent, were owner occupied, with a median value of $24,200. In Somerville, 9,884, or 34.1 percent, of the 28,999 occupied units were owner occupied: the median value was $16,700. Arlington had 57.3 percent--10,075 units--that were owner-occupied, with a median value of $25,800.

The low percentage of owner-occupied units in Cambridge and Somerville can be attributed, in part, to the fact that homes have been converted into small rental units to accommodate student housing needs. In 1960, 22.5 percent of the housing units were owner occupied in Cambridge and 35.8 percent in Somerville.

Renter Occupied

In Cambridge, 29,421 of the occupied units were renter occupied. The average monthly contract rent was $119. Somerville had 19,115 rental units with an average monthly rent of $97. Of the 17,548 occupied units in Arlington, 41.1 percent--7,227--were renter occupied; the average rent was $143.

Housing Density

In Cambridge, the average number of persons per household was 2.43; while in both Arlington and Somerville, the average was 3.0 persons. The concentration of students may explain the lower figure in Cambridge.

In contrast, Cambridge has ten percent of its population in group quarters--11,859--again, reflecting the high number of students. Somerville had 1,799 (two percent) while in Arlington, only 282 (0.5 percent) were housed in group quarters.

Retail-Wholesale Market

The Boston Metropolitan area has historically ranked as a major wholesale and retail center and, in the past, activity has centered in the City of Boston. Since the Second World War, however, there has been a decentralization of retail and wholesale activity that has generally coincided with population decentralization. Data on retail sales indicate that the inner ring communities have maintained constant sales levels while the outlying towns have shown a substantial growth in sales.

In terms of retail sales, Cambridge was the dominant community in the Northwest Subregion. The 1967 volume of $266 million represented approximately 28 percent of the total sales of the subregion. Between 1963 and 1967, retail sales in Somerville were nearly static, but most of the communities in both the inner and outer suburbs, including Arlington and Cambridge, showed modest but significant increases. Table II-30 shows the BTPR retail profile for the Northwest Subregion.

Four principal shopping districts--Central Square, Harvard Square, Porter Square and the Fresh Pond Parkway Shopping Center--accounted for nearly one-third of all establishments in Cambridge and 43 percent of its sales. The Davis Square area in Somerville accounted for 13 percent of the City's retail establishments and about 17 percent of its total sales volume.

As seen in Table II-30 the number of retail establishments in both Cambridge and Somerville declined during the 1963-1967 period; Cambridge by 12.7 percent and Somerville by 13.5 percent. Arlington, on the other hand, gained 10.5 percent. All three, however, gained in retail sales during that period by approximately 11 percent.

A retail sales profile prepared by BTPR noted that retail sales activity in the Northwest Subregion tended to concentrate in older, established shopping areas such as Harvard, Porter and Davis Squares.

Table II-30

HISTORICAL RETAIL PROFILE: NORTHWEST COMMUNITIES

COMMUNITIES	1967 EST.	PERCENT CHANGE 1963-67	1967 SALES (1000)	PERCENT CHANGE 1963-67	1967 EMP.	PERCENT CHANGE 1963-67	RETAIL SALES CONCENTRATION (2)
CORE							
CAMBRIDGE	909	-12.7	265,971	+11.8	9,138	+ 3.6	1.54
SOMMERVILLE	565	-13.5	90.400	+ 9.4	2,896	+ 5.2	.61
SUB TOTAL	1,474	-13.0	356,371	+11.2	12,034	+ 4.0	
INNER SUBURBS							
ARLINGTON	296	+10.5	49,417	+12.6	1,312	+ 1.5	.54
BELMONT	188	+20.5	35,459	+11.7	1,066	+ 1.5	.72
LEXINGTON	151	+15.3	40,869	+32.3	1,334	+36.4	.75
MEDFORD	437	+11.5	119,116	+16.8	3,510	+13.3	1.14
WALTHAM	472	+ 5.6	131,973	+25.7	5,285	+23.0	1.33
WATERTOWN	268	-11.0	50,382	+ 7.4	1,301	- 7.9	.73
WINCHESTER	125	+15.7	21,772	+28.0	631	+21.1	.58
WOBURN	225	+10.8	62,065	+37.8	1,620	+18.7	1.02
SUB TOTAL	2,162	+ 7.8	511,053	+21.0	16,059	+14.9	
OUTER SUBURBS							
BEDFORD	63	- 4.5	17,571	+34.5	599	+18.4	.94
BILLERICA	89	NA	26,958	NA	911	NA	.66
BURLINGTON	89	+41.3	20,674	+44.7	740	+26.7	.61
CARLISLE	NA	NA	NA	NA	NA	NA	NA
CONCORD	125	+5.9	25,971	+34.2	872	+17.1	1.03
LINCOLN	12	NA	NA	NA	132	NA	NA
SUDBURY	NA	NA	NA	NA	NA	NA	NA
WAYLAND	41	- 2.4	7,591	-1.2	277	NA	.35
WESTON	25	NA	NA	NA	616	NA	NA
WILMINGTON	84	+25.4	26,675	+45.5	628	NA	1.01
SUB TOTAL	528	+12.9	125,422	+35.5	4,775	+20.5	
TOTAL	4,164	+ 1.1	992,846	+19.3	3,2868	+11.7	

NA: Not Available

1) Not adjusted for inflation
2) Derived from per capita sales per town, divided by average per capita sales for the state.

Source: U.S. Census of Business, 1963, 1967.

NA: Not Available

1) Not adjusted for inflation
2) Derived from per capita sales per town, divided by average per capita sales for the state.

Source: U.S. Census of Business, 1963, 1967.

Table II-31

RETAIL CENTERS: HISTORICAL SALES AND EMPLOYMENT BY STORE TYPE

	General Merchandise	Food Stores	Auto Dealers	Gas Stations	Apparel and Accessories	Furniture and Furnishings	Eating & Drinking	Drug and Prop.	Building Materials	Misc. Retail	TOTAL	Sales	Employment
HARVARD SQ.	2	8	1	3	36	19	42	15	2	43	171	$ 40,316,000	1600
PORTER SQ.	5	7	2	1	16	5	25	4	3	17	85	26,876,000	1200
DAVIS SQ.	11	9	0	5	17	13	23	3	3	5	89	15,267,000	(800)
ALEWIFE	2	4	2	7	3	3	8	1	4	8	42	17,572,000	850
ARLINGTON CENTER	4	13	3	0	5	4	17	4	2	10	62	15,000,000	500
ARLINGTON HEIGHTS	2	3	0	2	5	0	17	4	2	10	45	8,000,000	250
BELMONT CENTER	5	4	0	0	9	1	5	2	1	3	30	(5,000,000)	(200)
LEXINGTON CENTER	2	3	0	1	7	2	6	5	1	6	33	(5,500,000)	(220)
WINCHESTER CENTER	4	2	0	3	9	2	3	6	1	3	33	(5,500,000)	(220)
TOTAL	37	53	8	23	107	49	146	44	19	105	590		

Source: U.S. Census of Business, 1967. BTPR field surveys and estimates and local community planning departments.

Construction and Operations Impacts

The construction of the Harvard Square to Arlington Heights section would have significant economic impact on the metropolitan area.

The manpower required at the site would generate approximately 10,850 man-years of employment, representing 2,700 site jobs, with a total payroll of between $180,000,000 to $190,000,000. This increase in the flow of money could considerably increase the overall employment in the general area.

Project related employment could also be expected to increase due to the purchase of materials for the project which are expected to amount to $124,000,000. Some of this, such as concrete, lumber, and tile, would be locally manufactured and the retail value would approximate $63,000,000. The remaining materials would probably not be of local origin, but some would pass through local dealerships and others, such as structural and reinforcing steel, would require local operations.

The purchase and renial of construction equipment is expected to cost $81,000,000 and some would be spent locally.

The total impact of these requirements would generate local payrolls of $262,480,000 for work directly connected with the construction project.

Population Projections and Impacts

The projections discussed in this section are based on estimates by CTPS prepared in August 1974 and revised in March 1975. Table II-32 shows recent trends and projections for the three study communities.

These projections indicate that both Cambridge and Somerville are expected to continue losing population through 1980; Cambridge at a rate of 3.6 percent and Somerville at 9.2 percent. According to the CTPS projections, by 1995, Cambridge is expected to reverse the trend and begin to regain population. Somerville, however, is anticipated to continue losing population, though at a lesser rate of 2.5 percent. Arlington is projected to stabilize through 1980 and gain modestly by 5.7 percent during the 1980-1995 period.

According to the BTPR:

> The Red Line will not significantly change the overall distribution of population in the corridor nor is it likely to have any significant impact on the total population in the corridor. Its major long-range impact, therefore, will be the creation of nodes of higher density residential development at the various transit stations along the line.
>
> At the subregional level, the effect of the transit improvements would be to encourage increased population density in proximity to station locations. The Porter Square and Davis Square alternatives, by traversing high transit usage areas, would have more of a tendency to maintain residential density. However, the full transit extension would probably not halt migration from the central City communities. Two factors are at work in this case, both related to population distribution and transportation investment.

Table II-32

POPULATION TRENDS AND PROJECTIONS: STUDY MUNICIPALITIES

	1960	1970	Percent Change 60-70	1980	Percent Change 70-80	1995	Percent Change 80-95
Arlington	49,953	53,354	7.1	53,000	--	56,000	5.7
Cambridge	107,716	100,361	-6.8	100,000	-3.6	105,000	5.0
Somerville	94,697	88,140	-6.2	80,000	-9.2	78,000	-2.5
Northwest Sub-Region	618,771	676,472	9.3	733,100	8.3	815.6	10.1

Source: CTPS Technical Memo

Employment Projections and Impacts

The employment projections in Table II-33 are from the BTPR Red Book and are based on BTPR rather than the CTPS population projections. The employment projections are based on two sets of circumstances, represented by the high and low projections. Table II-25 shows the change in employment in the BTPR Study Region between 1960 and 1968. Future employment projections are shown in Table II-33. Declining birth rates would indicate the likelihood that the low projections will be the more pertinent. Therefore, the BTPR used these lower figures as the basis for all employment projections, with varying rates of labor force participation. This would not substantially affect the 1980 BTPR employment forecasts, but would affect projections beyond 1980.

According to the BTPR:

> "The long-range effect of extending the Red Line to Route 128 would generally be to accelerate the redevelopment of Alewife and reinforce the older existing centers of Harvard, Porter, and Davis Square. The components of this impact relate to the existing growth patterns in the metropolis and impacts related to population and labor force and the expansion of the trade areas of existing local business.
>
> "The effect of extending the Red Line to Route 128 would generally be to encourage new employment centers in the Northwest corridor and reinforce the older existing centers."

The town of Arlington had a study prepared by Gladstone Associates to analyze the economic development potential of Arlington Center. Their findings, published in the Mill Brook Valley Plan, indicated that Arlington could anticipate 1,730 new jobs due to the Red Line Extension--580 would be in retail sales, and 1,150 would be office jobs.

Table II-33

EMPLOYMENT BY INDUSTRY DIVISION, BOSTON SMSA,
1967, 1971 AND PROJECTIONS TO 1975 AND 1980

Industry Division	Number of Employees (Thousands)					
			Low Projection		High Projection	
	1967	1971	1975	1980	1975	1980
Agriculture and Mining	4.0	3.2	2.4	1.0	2.5	1.8
Construction	50.2	54.5	57.0	62.0	59.0	64.0
Manufacturing	316.2	278.8	307.2	314.0	319.0	335.0
Transportation, Communications, and Public Utilities	70.0	74.7	79.0	86.0	82.0	90.0
Trade, Wholesale and Retail	242.8	286.6	290.0	320.0	294.0	326.0
Finance, Insurance and Real Estate	84.8	94.6	105.0	126.0	110.0	137.0
Services	274.9	301.9	327.0	363.0	348.0	415.0
Government	166.3	178.9	192.0	208.0	196.0	223.0
Totals	1,209.2	1,253.2	1,377.7	1,480.8	1,410.4	1,591.0

Source: BTPR based on data from the Boston Redevelopment Authority, the Metropolitan Area Planning Council

Retail Sales

In the short-run, the first impact of the Red Line Extension on retail sales would be caused by the displacement of 15 businesses. (The specific impacts of each station are analyzed in later chapters.) In general, the recommended plan would reduce the number of business takings from the number required by alternatives in the BTPR Study--especially at Davis Square.

In the long run, after the proposed Red Line Extension is opened, there would be positive benefits to retailers in the station areas. As the ridership demands indicate, thousands of people would board at each station. This would generate several thousand potential customers for the stores and shops near the station entrances. In addition, many of these boarders would be walk-in riders who would pass the retail stores in the streets adjacent to the stations. Moreover, increased mobility and decreased travel time would benefit established retail centers. As the BTPR noted:

- "This increase in access would tend to increase business potential for existing businesses, and depending on the current supply-demand balance, could generate demand for expansion. The extent to which improved access actually generates new demands depends to some extent on the alignment of existing business competition and the relative cumulative attraction."

- "For those retail centers not as established, benefits would still accrue from the improved access and increased mobility. The effect throughout the entire corridor would be for a transit improvement of the quality of the Red Line to provide a forceful stimulus for accelerated growth of economic activity at the various station locations. As such, it represents an opportunity for the local jurisdictions to modify or renew these areas in accordance with their long-range objectives."

The Draft Report of the Mill Brook Valley Plan projected that 175,000 square feet of new retail space and 230,000 square feet of new office space would be developed in Arlington as a result of the Red Line Extension. Without the extension, 75,000 square feet of new retail space and 50,000 square feet of new office space would be anticipated within the next 15 years.

Impact on Taxes and Land Values

The immediate effect of the project on local taxes would be a negative impact in the magnitude of $116,700 which would represent the tax value of properties and businesses relocated by construction. Table II-34 shows projected impact on local tax base by municipality for each of the alternatives. In the long run, this may be offset by increased property values, particularly near station areas.[1] Experience with recent transit extensions tends to reinforce this opinion. BTPR explained that:

> "There is a tendency for a transportation improvement to cause a net increase in total land value and property taxes in a community by creating greater economic efficiency through increased accessibility. This attracts new development capital to that community rather than to other competing locations. That is, economically speaking, a transfer rather than a creation of benefit. Experience has shown that land values along transit lines increase with the greatest increases being experienced nearest transit stops for accessibility sensitive uses."

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[1] Asher, Joe, "If Transit Comes, Can A Real Estate Developer Be Far Behind," Railway Age, November 8, 1971, pp. 32-34.
Anderson, Arnold C., "The Effect of Rapid Transit on Property Values," The Appraisal Journal 38, January 1970, pp. 59-68.

Table II-34

PROJECTED IMPACT ON LOCAL TAX BASE

Alternative	Total Annual Tax Loss	Cambridge Tax Loss	Somerville Tax Loss	Arlington Tax Loss
Harvard Square-Alewife	$34,715	$33,900	———	$815
Harvard Square-Porter Square	55,115	54,300	———	815
Harvard Square-Porter Square-Davis Square-Alewife				
with railroad relocation[1]	64,715	54,300	9,600[2]	815
without railroad relocation[1] (Project)	61,915	54,300	6,800[3]	815
Harvard Square-Davis Square-Alewife				
with railroad relocation[1]	44,315	33,900	9,600[2]	815
without railroad relocation[1]	41,515	33,900	6,800[3]	815

1-Refers to the possibility of termination of rail services in the Davis Square Station location area.
2-Does not reflect partial taking of the Middlesex Federal Bank, Kolokithas Upholstery Co. or the Comfort Pillow and Feather Company.
3-Does not reflect partial taking of the Middlesex Federal Bank.

Induced land use changes could be encouraged by the possible increase in land value. Pressures for changes in land use would be especially felt in Davis and Porter Squares and Alewife. In Davis and Porter Squares, the BTPR recognized the potential demand for rooming and boarding units from students enrolled in the educational and cultural facilities in the Harvard Square area. Davis Square, particularly, has experienced an influx of students in recent years and single-family homeowners have found it profitable to vacate and subdivide their homes into rental units. The proposed transit extension would reinforce, if not accelerate, this process unless local land use and zoning measures were enacted. Developers would also seek to assemble lots and construct mid-rise and high-rise apartments. Land values at Alewife would be likely to reflect the potential development of more intensive office and retail use.

One of the most critical variables in this potential development would be the policies regarding zoning, taxes and land use. A study of recent transit extensions indicates that the enactment or the failure to enact regulations to support public policy can accelerate or contain land development in the vicinity of the station. [1]

Compatibility with Current Plans and Proposals

Although the BTPR indicated that the Alewife area was "highly suitable for extensive redevelopment," there is, at present, no unified plan for the development of this area. The function of the Joint Development Task Forces will be to evolve directives to coordinate development efforts. The BTPR Study identified various groups in Alewife that were sufficiently interested in economic growth to the extent that proposed plans for recreational and commercial developments had been suggested.

According to the BTPR, the extension of the Red Line through Alewife could function to encourage redevelopment of the area:

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[1] Marcoll, O'Leary & Associates, "Transit Impact on Land Development--A Review of Recent Experiences," June 1971.

> "One concern of many BTPR participants as well as past technical studies at Alewife has been to utilize the station location as a means of revitalizing the area...If the station is built at Alewife, there will be an opportunity to employ the project as a catalyst to areawide redevelopment. However, the prospects for such spin-offs depend very strongly on the scale at which the initial project is conceived, the timing of its development, and the involvement of a variety of public and private development interests."

The goal of allowing maximum flexibility for growth and development in the Alewife area and the coordination with plans for improving Route 2, influenced the selection of the location of the Alewife Station and were major concerns of the Alewife Task Force.

Economic development would not result solely from the extension of rapid transit. Local policy, assessibility by other modes, economic conditions, and availability of land and money would affect the degree to which transit could actually influence the type and rate of such development. These factors are discussed in the Joint Development subsection of Chapter IX of this report.

GEOLOGY

A general picture of the subsurface conditions was obtained from numerous test borings for projects and studies near the proposed project and some taken specifically for this project.

Harvard to Alewife

The generalized geologic profile for this segment is shown on Figures II-1B & C. The geologic legend presents brief descriptions of each layer. The geologic profile between borings was interpolated so the actual details may vary because of the erratic nature of the area's geology. The profiles, however, are generally realistic and reliable for a study of the present scope. The profile reflects the boring program for the pre-grant engineering phase.

The major stratigraphic units are identified from the surface downward: fill; sand and gravel; clay; clay and sand; till; and bedrock.

One or more of these units may be absent locally because of the erratic geological history of glaciated areas or subsurface disturbance by man.

The stratigraphic profile shows very complex soil and rock conditions. There is no continuous distinct geologic unit within which a tunnel could be constructed. Any tunnel excavation would encounter various soils and/or rock.

A tunnel completely within the rock was not considered feasible after the initial borings showed bedrock to be as much as 80 feet deep. The bedrock near Harvard Square in addition is a weathered and broken volcanic tuff, and the majority of the bedrock (the Cambridge Argillite) was broken to very broken at the depths drilled. However, during the pre-grant engineering phase, it became apparent that a deep rock tunnel is feasible between Porter and Davis Squares. The project does include an all rock tunnel and station. See Chapter IV.

The best soil type available for runneling is the clay, contiguous sands, the upper surface of the glacial till and bedrock. Tunnel construction will encounter coarse till, sands, and/or bedrock, and the exact tunneling method must be very flexible to accommodate these extremely variable conditions.

Alewife to Arlington Heights

The generalized geologic profile for this segment is shown on Figures II-1D & E. The geologic legend presents brief descriptions of each layer. Between Harvard and Alewife, specific borings from other studies along the project alignment were available. Fewer sources of existing data were available between Alewife and Arlington Heights. Nine -30 to 35-foot-deep borings were taken in November 1952 by the then MTA. Many borings are available adjacent to the route between Arlington Center and Arlington Heights. Most of these borings were taken for the MDC - Sewer Division. The geologic profile is based on interpretation of driller's description of test boring logs. Some generalizations have been made for the purpose of the stratigraphic profile. Specifics may be found in the boring logs.

The pre-grant engineering phase is about to start on this segment. Soils information should become available in the Summer of 1977.

The major stratigraphic units are identified from the surface downward: fill; peat; sand with some gravel; sand and clay; and bedrock. Descriptions of the individual strata are given in the Supplemental Data Volume.

The stratigraphic profile shows mixed soil conditions. The proposed construction consists of tunnel/cut-and-cover. Construction would be within the fill and sand with some gravel stratum. It appears that the excavation may be in bedrock in certain areas. A more extensive subsurface exploration program will be required prior to final design. Results should be available in the Summer of 1977.

The analysis for tunnel/cut-and-cover construction is similar to that described for the Harvard-Alewife segment. However, additional groundwater and bedrock data may revise this early assessment.

Intermittent peat deposits would present some construction problems requiring the removal of all peat within the limits of subway construction and replacing it with sand or gravel.

Dewatering would be necessary in certain instances to control gradients and keep the excavation dry. The groundwater would also have to be controlled in open excavations to prevent erosion and slope failures.

HYDROLOGY

Alewife Brook

Alewife Brook drains a watershed of approximately 5,300 acres, including parts of Watertown, Belmont, Arlington and Cambridge. The major impoundments located in the watershed are Spy Pond, Little Pond, Clay Pit Pond, Blair Pond, Perch Pond and Jerry's Pond. Each of these ponds varies considerably in water quality and hydrologic function.

Surficial deposits along Alewife Brook have a limited water absorptive capacity and are underlain by a saturated and impermeable clay barrier. Consequently, the water table in the Alewife Area remains close to the ground surface--within six to ten feet. These factors, coupled with localized urbanization and industrial development cause much of the precipitation falling on the area to run off directly into the brook rather than being absorbed or otherwise retarded before reaching the brook.

A computerized flood control study of the Mystic River and Alewife Brook by Charles A. Maguire and Associates, based on Hurricane Diane of August 1955, revealed that the crest level of Alewife Brook peaks soon after the peak intensity of the rainfall. Run-off time is rapid because of the extensive development and lack of absorptive soils or vegetation. Thus, potential flooding is a severe problem.

In addition to intrinsic flood potentials in the watershed, the flooding problems at Alewife Brook are closely related to the conditions in the Mystic River Basin. The MDC normally maintains the Mystic River Basin at an elevation of 107. At this elevation, Alewife Brook and its watershed have the storage capacity of approximately seven million cubic feet of water. A rapid rise in the basin level cuts off the outflow of water from Alewife Brook, causing it to back up. With only a one-foot increase in water level in the Mystic River Basin to 108, some flooding in the low-lying floodplain along Alewife can be anticipated. Localized flooding may also occur along Alewife Brook during minor storms as a result of the limited capacity of the stream bed due to sediment accumulation and the retardation of water flow resulting from constructions at bridges and culverts through which the storm water must pass.

During Hurricane Diane, extensive flooding occurred in the Alewife area causing considerable damage to homes and businesses. The intensity of the rainfall during the hurricane was slightly more than for a 100 year storm. The flood level was about six to seven feet above normal. Since Hurricane Diane, the Alewife region has been further developed to an extent that a similar or less intense storm could cause similar or greater damage. A brief description of flooding in the municipalities abutting Alewife Brook follows.

Town of Arlington (East Arlington)

Lafayette Street from Herbert Road to the old Boston and Maine branch line including the rear yards on Fairmont Street suffers severe flooding problems when the Alewife Brook exceeds elevations of 110. Elevations taken by instrument in November 1969, indicated a brook level of 106.8. After the heavy rains of December 26, 1969, readings were again taken at the extremity of the flood waters and an elevation of 110.34 was indicated. This rise of 3.5± caused severe damage to parked vehicles and to the rear yards on Fairmont Street.

The Magnolia Park (Town of Arlington unimproved playground) area between Thorndike Street, the rear property line of Varnum Street, Herbert Road and the old Boston and Maine branch line are drained by a storm sewer into Alewife Brook. The elevation of the invert of this storm sewer is 107.2. When Alewife Brook rises above this elevation, flooding in this area occurs. Due to complaints of numerous abutters, the Town, after acquiring this property, was forced to install a manually operated gate to retain the backup from the Alewife Brook and an ejector pump to bypass the gate and drain this area.

The area in the rear of 107 to 131 Sunnyside Avenue also experiences severe flooding when Alewife Brook exceeds elevation 107.

Town of Belmont

Belmont has three major drainage areas that discharge into Little River and eventually into Alewife Brook. They are the Bird's Pond outlet which drains a part of the Payson Park area and Harvard Lawn section of Belmont; the Wellington Brook drainage area which originates at Lexington and Belmont Streets; and the Winn Brook drainage area which includes the general Winn Brook area and the majority of Belmont Hill.

The Bird's Pond and Wellington Brook watersheds comprise 1,385 acres or 45 percent of the entire area of the Town. This water drains through Blair Pond to Perch Pond, Little River, thence to Alewife Brook.

The Winn Brook watershed consists of 725 acres and comprises an additional 25 percent of the area of Belmont. This water discharges into Little Pond and joins the other two Belmont watersheds at Perch Pond, making a total of 70 percent of Belmont draining to Alewife Brook. Also adding to this watershed is Spy Pond in Arlington which is connected by an overflow outlet to Little Pond.

Because of the geographical contour of the town, Belmont has little control of these natural watersheds which contribute water to Alewife Brook. While much of the three watersheds are quite high, the lower Winn Brook area and the Hittinger Street section of Wellington Brook would be, and have been, greatly affected by any flooding or lack of run-off from Alewife Brook.

The floodplain of the Little Pond area has been greatly reduced during recent years. In 1931, the MDC land in Belmont including Little Pond consisted of 42.7 acres made up of the 18.7-acre pond and 24 acres of land.

By 1955, the year of Hurricane Diane, several pieces of land had been sold off reducing the area to 39.3 acres consisting of the 18.7-acre pond and 20.6 acres of land. By 1957, the MDC skating rink further reduced the land area by two acres leaving the 18.7-acre pond and 18.6 acres of land for a total of 37.3 acres. The Route 2 widening and new cloverleaf in 1967 reduced the pond to 18.0 acres and the land area to 16.1 acres, for a total of 34.1 acres. This is 5.2 acres less than 1955, the year of the record storm and 8.6 acres less than 1931. These figures represent the area in Belmont only and do not take into account the wetlands lost in Cambridge by the construction of A. D. Little, Inc., Acorn Park Road, etc.

During Hurricane Diane in August of 1955, Little Pond rose 5.5 feet to elevation 112.5. Three days after this storm, Little Pond was still 1.5 feet above its then normal elevation. The elevation of the water in Little Pond since about 1965 is 0.5 higher than previous records, dating back to 1928, show. While 107.0 used to be the normal elevation, the water today averages 107.5. This increase seems to coincide with the construction of the Amelia Earhart Dam set at elevation 107.0. Little Pond flooding since 1955 is as follows: Elevation 111.1 in September of 1962, 109.8 in March of 1968, 109.3 in March of 1969, 109.8 in March of 1972 (after two days of rain), 110.0 in June of 1972, 109.5 in November of 1972, and 109.0 in April of 1973.

The Department of Natural Resources reported in November 1970 that Blair Pond was essential to proper flood control in the Alewife watershed. Their findings stated:

> Extensive encroachment of the Mystic River Watershed has occurred since the damaging floods of 1955. This filling of the floodplain has significantly reduced flood storage volume, thereby increasing the potential of a more damaging flood.

Flood Control Considerations

Although the new Amelia Earhart Dam in the Mystic River Basin was put into operation in 1966, its flood control capabilities had been seriously hampered by the inability of the MDC to obtain the recommended pumping equipment. Without the custom built pumps, the MDC was unable to maintain a level of 113.0 during a 100 year storm. However, new pumps are in operation and should encourage adequate flows from Alewife Brook.

The installation of the pumping equipment is part of a five-point program the MDC has embarked on to improve flood control along the brook. Other points included in the program are:

- Removal of Craddock Dam.
- Dredging silt deposits along Alewife Brook.
- Removing debris and obstructions.
- Instituting land use controls to minimize floodplain encroachments.

The MDC, with partial funding from the MBTA, is undertaking a Hydrology Study of the Mystic River and tributaries from the newly constructed Amelia Earhart Dam. Data from this study is expected to be available to the MBTA in late 1977. This data combined with the ongoing soils exploration, and testing will be utilized in the design of the Red Line tunnel/cut-and-cover through the Alewife Brook Reservation, East Arlington and Spy Pond Area. The following is an outline of the scope of work of the MDC Study:

> The Consultant will prepare a comprehensive report detailing the existing hydraulic capacity of the Mystic River Watershed. The report shall recommend various methods of flood control which can be implemented for area defined with emphasis on the cost effectiveness of each proposed method. Included in this study will be the following considerations:

1. The impact of the proposed construction of an MBTA station/garage and associated roadway improvements on the Alewife Brook/Little River area.

2. Impacts of proposed flood control improvements on present and proposed land use developments.

3. Channel improvements to the Mystic River or tributaries within the defined study area.

4. Dredging improvements to the Mystic River or tributaries within the defined study area.

5. Replacement or supplement of the discharge capacities of the river or tributaries within the study area by excavation of new channels for flooding abatement in addition to utilization of selected existing channels for recreation.

6. The construction of larger covered conduits.

7. Acquisition of additional parcels along the watershed whose purpose would be to increase the natural valley storage capacity of the watershed.

8. Further utilization of existing upstream storage ponds as flood storage sites.

9. Shore improvements along the banks of the Upper Mystic Lake to prevent erosion.

10. Combinations of the above.

11. Groundwater and field permeability studies for MBTA Tunnel/Station.

12. Hydraulic studies to determine preliminary elevations for 100-year flood at Alewife Station (+ 0.5 ft.)

Besides these MDC flood control efforts, a number of feasible techniques exist to alleviate and/or eliminate any potential flood impact induced by the proposed Red Line station and alignment in the Alewife area. The specific measures are discussed in Chapter VI. The two following possibilities are examples of techniques to control runoff produced from the Alewife station area:

- Retention Ponds--These are designed to maintain a set water level. Run-off from a rainstorm is stored within the pond for a short period of time and is slowly discharged until the pond level is reduced to normal. These ponds also provide an attractive setting and can be coupled with small open space recreational areas.

- Detention Ponds--These ponds are designed to remain dry during periods of no rain. During heavy rains, excessive run-off is channeled to the pond and stored until it can be released to conventional drainage channels.

For a description of the impacts on the Little River during construction refer to page VI-103.

Groundwater

The Environmental Analysis Report for the Red Line Extension was reviewed by the New England Consortium on Environmental Protection for the Massachusetts Executive Office of Environmental Affairs. The following is a direct quote from their report, pages III-36, III-37, and III-38:

"4. Ground water and subsurface drainage: The major reasons for protecting ground water levels are to avoid settling of structures, cracking in foundations, and dehydrating vegetation. Dewatering must be done very carefully to avoid impacts on adjacent properties. Some special watering of parklands and vegetation may be necessary because of dewatering. Design procedures for cut-and-cover construction should provide for sealing the tunnel excavation. This would maintain ground water levels as near present conditions as possible and avoid a muddy water disposal problem created by water seepage into the tunnel construction area.

"In most sections of Arlington, the soil is primarily sand or gravel and would allow for reasonable subsurface drainage flow and the maintenance of water levels. In Cambridge and Somerville, impermeable clay deposits occur periodically and ground water flows become more significant. The DEIR is very brief on ground water flows, because of the hidden complexity of underground water movements. In order to avoid undesirable side effects, the tunnel should be

constructed on a permeable sand/gravel base wherever it must pass through impermeable clay layers. Then there would be the possibility for water seepage flow under the tunnel structure. This seepage would balance the water levels on both sides of the tunnel and prevent the collection of stratified levels of stagnant groundwater--especially at Alewife. By providing a permeable gravel base under the tunnel, it would be possible to prevent the tunnel from being a 20-foot high wall restricting ground water flow.

"5. Fresh Water Quality and Supply: Although there are no private wells in the Cambridge/Arlington area, some of the groundwater in the Fresh Pond/Alewife region is occasionally drained off by the Cambridge Water Department as a secondary water supply source when the Hobbs Brook Reservoir is below capacity.

"The DEIR makes no mention of the significance of the groundwater supply to the City of Cambridge. Geologically, Fresh Pond is closely tied to the Mystic Basin watershed. Fresh Pond used to flow directly into Alewife Brook (formerly the Menotomy River) with Fresh Pond Meadow on the west side of the Brook and the Great Swamp to the East. Much of this area has been filled in since the seventeenth century, with only Little Pond/Little River and Alewife Brook remaining visible at the surface. Despite this extensive landfilling, the wetlands/groundwater relationship remains between Fresh Pond and the Alewife area. The Cambridge Water Department will periodically lower the water level in the Fresh Pond reservoir over twenty feet through water usage, while shutting off the inlet from the Hobbs Brook Reservoir. The effect is to draw off groundwater from previous and existing wetlands areas and provide Cambridge with an alternate supply of drinking water.

"Therefore, there should be provisions within the Red Line Extension design to ensure that this occasional flow of groundwater will not be impaired in either quantity or quality. Seepage circulation around the tunnel must be maintained to prevent any development of stagnant ground water pockets."

Mill Brook

A 1974 study, "Mill Brook Hydrological Flood Plain Study", prepared for the Town of Arlington's Conservation Commission and Redevelopment Board is the basic source of information on Mill Brook flood conditions.

The drainage area of Mill Brook watershed consists of 2.15 square miles. The brook flows 2.84 miles from the confluence of Sickle Brook and the Arlington Reservoir overflow and empties into Lower Mystic Lake. However, Mill Brook flows only 40 percent of its total length in a natural channel; the remainder has been confined to a concrete and stone walled open channel for 34 percent of its length and has been completely hidden from sight in an underground series of conduits for 25 percent of its length. These conditions are a result of the almost complete development of land adjacent to Mill Brook and the need to utilize all remaining open areas to the fullest extent for such purposes as athletic and play areas.

Mill Brook's tendency to overflow its banks and flood the adjacent land during periods of intense rainfall has been aggravated by many undersized openings in bridges and by many culverts and underground conduits of very limited capacity. These structures cause the flow of water in Mill Brook to back up in the channel until it overflows the banks, and in many cases actually overtops the structures and flows overland, before returning to the main channel. These conditions have occurred in the past and will continue to occur whenever sufficient precipitation occurs.

Several restrictions and related hydraulic problems exist in the vicinity of the proposed Arlington Heights Station from Park Avenue upstream to Arlington Reservoir. Although the 12-foot by 3-foot opening of the Park Avenue bridge causes only minor backwater, little or no slope exists in the stream bed upstream from this point. Consequently, flooding results from moderately heavy rains and slight backups. A major problem exists where the brook is piped into two corrugated metal culverts of limited capacity under the Arlington Coal & Lumber Company; serious backwater conditions exist upstream of this point during 5-, 25- and 100-year storms. Further upstream, the Lexington Branch of the MBTA Commuter Rail System crosses Mill Brook at a low level and would be overtopped by the brook during a storm of greater than 25-year frequency. Before and after the railroad crossing, the brook is forced to make two sharp bends of approximately

90 degrees. At the MBTA Commuter Rail Line crossing, water would begin to flow down the railroad siding because of high back-water in the brook and the convenient pathway down the railroad tracks toward Forest Street. Above the Lexington Branch stream crossing, Mill Brook flows along the perimeter of the Colonial Village Apartments parking lot. Here the stream's gradient is nearly level and has a cross section of limited capacity with flow obstructions caused by logs supporting the concrete sides of the channel. Two more 90-degree bends are present in this area. Under the conditions of a 25-year storm or greater, the area around the Colonial Village Apartments would flood extensively.

Mill Brook becomes a natural open brook upstream of the Colonial Village Apartments and passes through the Arlington Heights Playground. The only restriction existing in that area is the foot-bridge near the playground. Under the bridge, four 36-inch pipes would be filled during storms of greater than the five-year intensity. The next point upstream of any hydraulic significance is the confluence of the Sickle Brook and the discharge from Arlington Reservoir. In the area of the Elderly Housing, the banks are of sufficient height to contain a flood flow. However, just downstream, the playground will be flooded over a large area.

In addition to these channel restrictions, four existing fences in the stretch of Mill Brook from Park Avenue to the Reservoir aggravate the hydraulic conditions by trapping branches, leaves, and other debris which prohibit free flow in the brook. Overall, this region of Mill Brook suffers from much deposition of silt and muck, which has lowered the capacity of the stream channel even during minor storms.

The U.S. Army Corps of Engineers is studying the hydrology of Mill Brook as a local protection project. The study is expected to start in July 1977. The results of this study will be coordinated with the Red Line Project.

In the course of subway construction in Arlington Heights, it will be possible to improve some of the substandard hydraulic conditions existing at the Heights; these improvements will potentially reduce the extent of flooding in the area. For a description of the Mill Brook improvements and relocation, refer to Chapter VIII under "Method, Duration and Sequence of Construction." Improvements to Mill Brook will require a permit from the U. S. Corps of Engineers (Section 404) and from state and local agencies (Wetlands Protection Act).

AIR QUALITY

Introduction

The air quality impact resulting from the proposed project is determined by the following factors:

- Regional meteorological and micrometeorological characteristics
- Areawide air pollutant emissions and their time variations
- Vehicle miles traveled (VMT) and its spatial distribution.

The factors not only govern pollution levels on a regional scale, but also dictate pollution levels at local problem areas, such as in the vicinity of proposed stations.

To fully disclose the effects of the proposed project on air quality, two major tasks were undertaken--mesoscale and microscale air quality analysis.

The mesoscale analysis consists of several elements: an examination of meteorological characteristics on a regional basis; an analysis of area-wide emissions of perticulate matter (PM), sulfur oxides (SO_x), carbon monoxide (CO), hydrocarbons (HC), and nitrogen oxides (NO_x); a review of existing air quality monitoring data; and modeled projections of carbon monoxide levels for both the build and no-build cases.

Dispersion analysis was restricted to carbon monoxide for the following reasons:

- The Set I pollutants (PM and SO_x) are emitted in insignificant quantities by motor vehicles. (See Table 3 of Appendix H.)
- Hydrocarbons and nitrogen oxides are unstable species which undergo a complex series of reactions resulting in the formation of photochemical oxidants (O_x). Proper dispersion analysis of $HC/NO_x/O_x$ requires the use of a photochemical model, but such models are very area-specific and have been validated only for the Los Angeles air basin.

It should be noted that, although HC and NO_x are not modeled, they are assessed on an areawide basis by comparing the emissions resulting from the build and no-build cases in Section II-B of Appendix H. It is commonly assumed that O_x levels are proportional to hydrocarbon emissions. Consequently, a rough estimate of the effects of the various alternatives on oxidant levels can be made by comparing the respective emission rates.

Microscale analysis includes CO air quality evaluation on a station specific scale for the Harvard Square, Porter Square, Davis Square, Alewife, Arlington Center and Arlington Heights areas. These analyses consider the motor vehicle activity induced by parking garages and stations. Detailed discussion is given in Appendix H, but the results are presented briefly at appropriate locations in this document.

Methodology

To assess the air quality impacts resulting from the proposed Red Line Extension project, regional and local air quality impacts studies were conducted. In addition, air quality impact as a function of time was investigated to differentiate short- and long-term effects. Both short-term impact as associated with construction activities, and long-term impact as a result of project operation were investigated.

Short-term impact resulting from project construction was focused on the increase of suspended particulate and carbon monoxide levels due to traffic interference and dust-generating activities. These impacts can be minimized through inclusion of provisions in the construction contracts.

Future operation of the proposed subway extension will bring about some change of transportation mode from private cars to public transit. This change will determine the future vehicle-miles traveled (VTM) in the corridor and its spatial partitioning as a result of subway station locations. Consequently, the intensity of pollutant emission in a given locality is influenced.

Air quality data collected by the Bureau of Air Quality Control of the Commonwealth of Massachusetts and pollutant emission data compiled by EPA were reviewed to establish baseline air quality conditions and emissions respectively.

Emission inventory analysis examined total suspended particulates (TSP), sulfur oxide (SO_x), nitrogen oxides (NO_x), hydrocarbons (HC), and carbon monoxide (CO). Pollutant emissions were predicted, by municipality, for HC, NO_x and CO and were based principally on the predicted traffic conditions. Regional analysis of total pollutant emissions before and after introduction of the proposed Red Line Extension was conducted in order to quantify emission impact in terms of emission reduction on a regional basis.

Baseline air quality situations were disclosed by a series of graphs which represent diurnal and seasonal variations of a given pollutant and frequency of occurrence of a given pollutant level. The existing air quality conditions were available in every case and were reported by the number of violations of either the National Ambient Air Quality Standard(s) (NAAQS) and/or the Massachusetts Ambient Air Quality Standard(s) (MAAQS). The pollutants analyzed were TSP, SO_2, CO, and photochemical ozone.

The future air quality impacts were evaluated in two steps. The first step examined the physiogeographic characteristics of the air shed in the metropolitan Boston region, and also researched the historic meteorological data compiled by the National Weather Services to disclose the prevailing wind field and the degree of pollutant dispersion or dilution in the study area. Secondly, with the aid of the APRAC-1A air quality model, the results of the meteorological study were directly applied to the region for pollutant dispersion simulation. Two major meteorological conditions, namely "worst" and "most probable" conditions, were utilized in air quality simulation to generate maps of pollutant isopleths representing build and no-build cases. Comparative study between build and no-build cases for a given category of meteorological conditions was then conducted to achieve two purposes: (1) quantification of regional air quality impact, and (2) identification of problem areas or "hot" spots requiring individual air quality impact study in microscale. Figure 33 of Appendix H shows the modeled results used for selecting the "hot spots" for this study, namely: the Harvard Square; Porter Square; Davis Square; Alewife; Arlington Center; and Arlington Heights areas.

Pollutant dispersion formulation, as suggested for indirect sources by the U. S. EPA, was employed to predict pollutant levels outside of facility rights-of-way for each individual problem locality. The resulting air quality was then evaluated against the pertinent NAAQS and MAAQS and air quality impact quantified for build and no-build cases. Effective mitigating measures were suggested for the areas having a negative air quality impact and these measures were included in the planning criteria.

Physical Features of the Metropolitan Boston Air Quality Control Region

The Metropolitan Boston area is designated by the Bureau of Air Quality Control of the Commonwealth of Massachusetts as Air Quality Control Region 119 (AQCR 119) and designated by the U. S. EPA as Air Quality Control Region I. The region lies in a flat coastal basin encircled by low hills to the south, west and north, and by Massachusetts Bay on the east. Elevations range from zero to 600 feet above sea level and average 100 feet above sea level. These topographical features, while not of major consequence, are of significance in confining the ventilation of the occasional sea breezes. Boston's east coast location greatly influences local climatology and meteorology.

Areawide Air Pollutant Emission Analysis

In the Air Quality Control Region, both stationary and mobile sources are major sources for pollutant emissions; however, vehicular emissions contribute more than 95%[1, 2] of the total regional emissions as far as the carbon monoxide (CO) is concerned, and will continue to remain so from now to the target year of the proposed project. Therefore, total CO emissions will continue to be a function of daily vehicle miles traveled (VMT) in the region.

Concentration of CO-- a relatively inert gas--is reduced primarily by atmospheric dispersion process. The local CO level is determined by the local CO sources, their emission strength and wind speed. Based on VMT projection and normal growth of non-vehicular sources, the total CO emissions at Kenmore Square were estimated as shown in Table 1 by the BTCP study for 1976, 1977, 1978, 1981 and 1984. Assuming unique ratio[1] between emission intensity (kg/day/mi^2), and CO concentration for a locality having uniform emission activity (or traffic activity), CO levels at Kenmore Square were calculated from the projected emissions as shown in Table 1, Appendix H.

The CO emission as well as its concentration will continue to decrease with time due to the ongoing Federal Motor Vehicle Pollution Control Program (FMVPCP); however, the decrease of CO levels without transportation controls will not be sufficient to meet the air quality standards by the 1977 deadline. The effects of the transportation controls are also shown in Table 1, Appendix H.

The study area of the proposed project is within five municipalities--Arlington, Belmont, Cambridge, Lexington and Somerville. After examination of previous traffic studies and vehicle registration records, each municipality was found to have different traffic demand and growth patterns. Based on the VMT growth, arrived

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[1] GCA Corporation, Transportation Controls to Reduce Motor Vehicle Emissions in Boston, Massachusetts, U.S. EPA, Office of Air and Water Programs, Research Triangle Park, N. C., November, 1972. (BTCP)

[2] 1972 National Emissions Report, National Emission Data System (NEDS) of the Aerometric and Emissions Reporting System (AEROS), U.S. EPA, Office of Air and Waste Management, Research Triangle Park, N. C., June, 1974

at from traffic studies; vehicle emission factors; model year distribution of vehicles; mixture of light- and heavy-duty vehicles; average traffic speed; and VMT's on primary traffic links and on secondary traffic roads; the total vehicular emissions of carbon monoxide (CO), hydrocarbons (HC) and nitrogen oxides (NO_x) for each municipality were calculated and are shown in Appendix H, Tables 2a, 2b and 2c, respectively. Heavy-duty vehicles are assumed to constitute 10% of the vehicle mix.

Considering CO alone and assuming uniform vehicular emissions throughout each municipality, the 1974 vehicular emission intensity for each municipality was calculated by dividing the total emissions by the square mile area of the municipality. The order of decreasing vehicular emission intensity, as shown in Appendix H, Table 2a, is Cambridge, Arlington, Somerville, Belmont and Lexington. The ranking also indicates the decreasing order of average traffic activity within each municipality with Cambridge ranked first and Lexington last. It has to be noted that this treatment does not preclude any possible problem areas in Lexington which has the least traffic activity.

Hydrocarbons and nitrogen oxides are well known as ingredients of photochemical reactions which lead to production of harmful photochemical oxidants or smog. The relatively long time lag between the release of hydrocarbons and nitrogen oxides and the formation of photochemical oxidants is the main reason for these reactions being a regional phenomenon. Therefore, emissions of hydrocarbons and nitrogen oxides can only be handled meaningfully on a region-wide basis. According to source inventory studies[2, 3] transportation contributes about 70% of the total hydrocarbon emissions and approximately 50% of the total nitrogen oxides emissions in the metropolitan Boston AQCR (air quality control region) as shown in Tables 3 and 4 of Appendix H.

Hydrocarbon emissions and oxidant levels within Route 128 region are based on the BTCP's[1] source inventory study and are shown in Table 4, Appendix H. The original study gives only the 1970, 1977, 1978 and 1979 values. By using rollback techniques, the emissions and oxidant levels are interpolated and extrapolated for 1974 and 1980 with allowance for normal growth of both stationary and mobile sources.

[3] Walden Research Corporation, Summary Report: Air Pollutant Emission Inventory for the Metropolitan Boston Air Pollution Control District (30 Municipalities), prepared for the Bureau of Air Quality Control of the Commonwealth of Massachusetts and the U.S. EPA, June, 1972.

Emission Factors

The most recent emission factors suggested[6] by the U. S. EPA are employed along with the necessary adjustments for average vehicle speed; deterioration of emission control devices in terms of model year and age; weighted travel by age of vehicle; vehicle distribution by model year; and mixture of light and heavy duty vehicles. The emission factors in terms of average vehicle speed are shown in Figure 36, Appendix H, for both the base and target years.

Traffic Data Input

Traffic data is established by utilizing the BTPR report[7] (The Red Book) prepared for the Department of Public Works and Massachusetts Bay Transportation Authority, the areawide TOPICS studies[8], and Transportation Facts for the Boston Region (1968/1969) for the five muncipalities.

Traffic volumes in 1970 on primary traffic links are delineated from the TOPICS studies. The traffic volumes in the base year (1974) are then estimated by the growth factors extracted from the trend of vehicle registration in each municipality. The same procedure is also used to establish the traffic volumes in the target year (1980).

The daily VMT (vehicle miles traveled) on the primary traffic network is the summation of the products of daily vehicle flow and traffic link length. The primary VMT, i.e., the VMT on primary traffic links, as shown in Figure 27, Appendix H, is treated in the simulation program as line sources. Secondary VMT deduced from the BTPR report is expressed in percentage of the primary VMT for a given municipality and is regarded as area sources in the computer program.

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[6] Compilation of Air Pollutant Emission Factors, U.S. EPA, Office of Air and Water Programs, Publication No. AP-42, Fifth Edition, Research Triangle Park, N. C., July, 1975.

[7] Boston Transportation Planning Review--Northwest Corridor, A Preliminary Environmental Analysis, Department of Public Works and Massachusetts Bay Transportation Authority, January 1973.

[8] Tippets-Abbett-McCarthy-Stratton, Engineers and Architects, Areawide TOPICS Plans (Traffic Operations Programs to Increase Capacity and Safety) for Arlington, Belmont, Cambridge, Lexington and Somerville, Massachusetts, Commonwealth of Massachusetts, Department of Public Works, Boston, Massachusetts, November, 1972.

As reported in BTCP[9], the maximum one hour traffic peak is considered to be 10% of the total average daily traffic (ADT) and the maximum eight hour traffic is 50% of the total ADT.

Finally, linkage between VMT and emission factors is provided by the traffic coding as shown in Table 6, Appendix H, to yield the emission strength of a given source.

Meteorological Data Input

Important meteorological variables required by the simulation model are transport wind, mixing depth and stability of atmosphere. The mixing depth is calculated using the surface temperature observation at Logan International Airport and the U. S. Weather Service's nearest morning (1200 GMT) upper air temperature sounding conducted at Chatham, Massachusetts. The stability index is evaluated by the prevailing cloud cover and wind speed.

Worst and most probable meteorological conditions, evolved from the wind rose analysis; the probability analysis of the historic atmospheric stability data aided with the radiosonde observations at Chatham; and carbon monoxide measurements at four state-operated air quality sampling stations were adopted for computation input. Using Chatham upper air data adds a degree of conservatism to the analysis, because the urban heat island in the Boston area tends to moderate the formation of extremely sharp ground-based inversions, which can otherwise result in a potential for greatly elevated pollutant levels.

The worst conditions are 1 m/sec wind, 100 meter mixing depth and Pasquill stability class D. The most probable conditions are 1000 meters in mixing depth, 14 m.p.h. wind and stability class E.

Alternative Cases

Considering the possible alternative combination of various traffic and meteorological conditions, 12 cases of modeling are generated and considered necessary to give a complete disclosure of air quality impact resulting from the proposed project. The conditions of these 12 cases are described in Table 7, Appendix H.

[9]GCA Corporation, Transportation Controls to Reduce Motor Vehicle Emissions in Boston, Massachusetts (Boston Transportation Control Plan), U. S. EPA Office of Air and Water Programs, Research Triangle Park, N. C., Dec. 1972.

It should be noted in Table 7, Appendix H, that the worst one-hour cases, i.e., case 1(a), 1(b), and 1(c) are in fact the worst of the worst cases with simultaneous occurrence of peak one-hour traffic and worst meteorological conditions, of which the joint probability of occurrence is undiscernibly small.

Spatial Distribution of Emission Sources

A Cartesian coordinate system is superimposed on the corridor area to define the geographical locations of all emission sources. Line sources of emission are represented by the network of primary traffic links and are located by the coordinates of the link ends. Part of the primary link network is shown in Figure 27, Appendix H.

A grid system having grid size of 2 x 2 miles is employed to describe the distribution of area sources within the corridor. Assumption is made that the CO emissions (besides those from the primary traffic links) surrounding a grid point are contributed uniformly from an entire 2 x 2 grid by the VMT on secondary traffic links within the grid. The whole emission grid system is presented in Figure 28, Appendix H.

Construction of CO Level Contour Maps

A total of 333 receptor sites, shown in Figure 29, Appendix H, are distributed uniformly to cover the 3-1/2 x 12 mile study area. Concentration of CO at each receptor site is computed separately. The 333 receptor sites are organized so that they form an array of grids 2000 feet x 2000 feet in size. This receptor grid size is considered small enough to reveal the regional air quality impact as a whole as well as to identify problem areas or hot spots in microscale.

The APRAC-1A model described above was used for generating patterns of CO concentrations for the 1974 base year and for target year 1980 under no-build and build conditions. Input data consisted of the following:

- CO emission rates calculated from VMT and corresponding emission factor data over 440 individual traffic links over the Red Line Extension area

- Meteorological data for wind, stability, and mixing height under: (a) worst case situations, and (b) most probable case situations.

The computer output consisted of predicted values of carbon monoxide concentration in parts per million at each of the 333 grid point intersections. These values were entered onto an

area base map and isopleths were drawn to show the pattern. The specific values were adjusted to conform with CO measurements reported for the Boston area in the GCA report. This adjustment step is referred to as model calibration (or "tuning"); it provides for realism and consistency between ground truth data and model predictions under simulated conditions. Projections on decreases in traffic due to auto diversions averaged over 24 hours and peak eight-hour and one-hour periods are shown in Figures 30, 31 and 32, Appendix H, respectively.

Areawide One-Hour Average CO Concentrations

Figures 33, 34 and 35, Appendix H, show estimated patterns of carbon monoxide concentration at one-hour peak traffic periods under worst-case meteorological conditions, for 1974, 1980 no-build, and 1980 build scenarios. The figures show that despite the slight anticipated increase in vehicular traffic between 1974 and 1980, a substantial reduction in CO concentrations should result if emission controls improve as expected. The projected reduction in CO emissions, shown by the July 1975 (fifth) supplement to the EPA document AP-42, "Compilation of Emission Factors", is from 67.5 g/mi to 31 g/mi.

A further reduction in CO concentrations will result from the projected decrease in auto traffic after the transit system is in operation. This reduction will be significant in the Cambridge area but far less so in Lexington. At best, the decrease due to auto diversion will not match that due to improved emission control.

In 1974, the estimated one-hour peak concentrations of CO under worst conditions appear to be just under the EPA Air Quality Standard of 35 ppm. Emission controls, whether with or without project construction, will provide for compliance with the standard by a safe margin.

Figures 36 and 37, Appendix H, show the estimated patterns of one-hour peak concentrations of CO under most probable meteorological conditions (wind WNW-11 mph, moderately stable lapse rate, average mixing height). The maximum concentrations of about four ppm in 1974 should be halved by 1980, and the additional reduction due to auto diversions in 1980 will not be significant alongside the one-hour standard.

Areawide Eight-Hour Average CO Concentrations

Figures 38 through 42, Appendix H, are analogous to the preceding set of five figures except that they apply to eight-hour average concentrations at peak traffic periods. Note, however, that the estimated eight-hour concentrations in 1974 under worst case meteorological conditions are shown to exceed 12 ppm, compared with the corresponding EPA standard of nine ppm. Improved emission control by 1980 should lower the maximum concentrations, with pockets of eight to nine ppm remaining in the Cambridge area. Improvement to compliance by a more comfortable margin, with maximal about six ppm, is expected to result from auto diversions following completion of the project.

Areawide Summary

From the preceding modeling analysis it is concluded that:

- The greatest improvement in air quality over the area as a whole will result from more effective control of CO emissions from automotive vehicles.

- However, while the one-hour EPA standard for CO will be met by emission control measures alone, compliance with the eight-hour standard by 1980 throughout all of Cambridge may be contingent upon construction of the Red Line Extension.

Areawide Summary — $HC/NO_x/O_x$

As noted earlier, no validated reactive models are available to analyze the complex relationship between hydrocarbons, nitrogen oxides and photochemical oxidants. However, HC and NO_x emissions, the precursors of O_x, are compared in Tables 2b and 2c of Appendix H for both the build and no-build cases. These results indicate that:

- Between 1974 and 1980, emissions of both HC and NO_x are substantially reduced as a consequence of the federal motor vehicle control program and other ongoing control programs.

- The 1980 build case shows lower emission rates for both HC and NO_x than the no-build case in every city or town within the study area. However, the differences are small in every case so no dramatic reductions in peak O_x concentrations or the frequency of violations should be expected solely from the project.

ENERGY

Energy Consumption

Energy consumption has become an important issue in every transportation project partly because of the increased costs and partly because of the potential supply problem. Energy consumption of transportation projects can be divided into two major elements - direct and indirect consumption.

Direct energy consumption includes all energy required to propel vehicles and to maintain and operate support facilities. Indirect energy consumption includes all energy expended to construct transportation facilities and to manufacture vehicles.

For the Red Line Extension, direct energy consumption for vehicle propulsion is estimated to be approximately 16.25 million kilowatt-hours-thermal (kwht) per year. This is based on the assumption that an additional 1,250,000 gals. per year of residual fuel oil will be required to generate electrical power to operate the Red Line Extension. This increase in fuel oil consumption by the Authority represents a 5.2% incremental increase over the 23,944,000 gals. per year used at MBTA generating stations to power the entire MBTA system (in 1972) and a .05% incremental increase over the 2,142,328,000 gals. of residual fuel oil consumed per year in the Boston Metropolitan Area (in 1972).

Direct energy consumption resulting from other direct uses of fuel for stations, maintenance, parking, and storage is estimated to be about 30 percent of vehicle operation energy consumption or an additional consumption of about 4.87 million kwht. Totalling the consumption estimates for vehicle operation and support facilities would produce an estimated direct energy consumption for the Red Line Extension of 21.12 million kwht per year.

Indirect energy consumption estimates for the Red Line Extension include 439.04 million kwht attributed to construction and 36.90 million kwht resulting from the manufacturing of 30 new heavy rail subway cars. These estimates are based on unit cost estimates of 68.6 million kwht for construction of one mile of subway tunnel and 1.23 million kwht for manufacture of one 60,000 lb. heavy rail subway car. Combining energy consumption estimates for construction and manufacturing results in a total indirect energy consumption of 475.94 million kwht, making the estimated indirect energy consumption for the Red Line Extension roughly equivalent to about 22 years of direct energy consumption. National figures for this comparison average about 10 years. The higher than average figure for the Red Line Extension results from the entire project being in a tunnel/cut-and-cover or deep bore section which requires much more energy to construct than a system combining elevated, at-grade and tunnel sections.

Energy Intensiveness

One measure of energy intensiveness or efficiency is passenger miles/gallon of fuel or equivalent values (PMPG's). Table II - 35 compares national averages for PMPG's for four different modes of transportation - automobile, bus, commuter rail, and heavy rail transit. This table also contains average miles per gallon of fuel consumed (MPG) for each of the four modes.

TABLE II - 35

ENERGY REQUIREMENTS OF PASSENGER TRANSPORTATION MODES

Mode	Vehicle miles per gallon of fuel or equivalent (MPG)	Passenger miles per gallon of fuel or equivalent (PMPG)
Heavy Rail Transit (car)		
Peak Hour	4.00	540
Off-peak Hour	4.00	140
Transit Bus		
Peak Hour	4.10	307
Off-peak Hour	4.10	123
Commuter Rail		
Diesel Powered	2.00	250
Average Commuter Automobile	13.5	19

Source: Traffic Quarterly, April 1976

The average daily PMPG value for the Red Line Extension on opening day is estimated to be about 70 passenger miles/per gallon of fuel consumed. This is based on the assumptions of a daily passenger mile figure of 243,249 and energy consumption equivalent to 3,472 gallons of fuel per day, calculated as follows:

202,708	(24-hour two way passenger miles, excluding Harvard Sq.)
40,541	(20% increase for reverse ridership from existing Red Line Stations)
243,249	Estimated total 24-hour passenger miles for Red Line Extension

$$\frac{243,249 \text{ pm}}{3,472 \text{ gals}} = 70 \text{ passenger miles/gal. of fuel consumed}$$

Average miles per gallon (MPG) for the Red Line Extension is estimated to be 2.9 (10,000 daily car miles/3,472 gals. daily fuel consumption), which is approximately 25% less than the 4.0 national average shown in Table II - 34 for heavy rail transit cars. This average efficiency of fuel consumption is below the national average because it was calculated using data on the existing Red Line system which receives power from Authority operated generating stations. In actuality, the Red Line Extension will receive electrical power from private utilities because the Authority intends to phase out its generating operations and switch over to private utilities by 1981. Therefore, it is expected that the Red Line Extension will run at about the 4.0 national average MPG for heavy rail trasit systems, once it is in operation.

The average passenger miles/gallon of fuel consumption (PMPG) projected for the Red Line Extension is relatively low when compared to national averages shown in Table II - 34. However, such comparisons are misleading because the figures in Table II-34 are for entire systems already in operation and the Red Line Extension is only one small segment of the total MBTA system, and being an end-of-line segment its ridership figures would naturally be lower when segregated from total line haul figures. Overall the Red Line system probably has a PMPG value approaching if not exceeding the national figures.

The PMPG figure for the Red Line Extension is also low because it is the result of comparing car miles to ridership on a line segment where the number of cars traveling the segment is dictated by the ridership requirements for stations closer into the CBD which have higher boarding counts.

Another consideration is the fact that the PMPG value for the Red Line Extension is an opening day value. Assuming a conservative increase in ridership of 5% annually, within thirty years the Red Line Extension, even considered separately from the rest of the Red Line System, could have an average PMPG value approaching 300 with little or no rolling stock being added to the Line.

Energy Savings

Direct energy savings can be attributed to a decrease in regional vehicle miles traveled (VMT) caused by work trip diversions from automobile to the Red Line Extension. An estimated daily decrease in VMT of 110,000 (see Table II - 16) with the Red Line Extension would save about 8,148 gals. of fuel per day (110,000 VMT/13.5 MPG). This figure is more than the fuel equivalency required to operate the Red Line Extension. It also represents a yearly savings of 2,444,400 gals. or about $1,466,666 per year (assuming a fuel cost of $.60 per gallon). Over thirty years, assuming a 2% increase in VMT reduction per year because of diversions, the accumulated savings would total about $59,500,000 (in 1975 dollars).

Energy Source

The source of electrical power to operate the Red Line Extension will be supplied from both Boston Edison at South Boston through the Authority's cable system to Bennett Substation and from local utilities at Porter Square and Alewife.

References

1. Indirect Energy Consumption for Transportation Projects, prepared for California Department of Transportation, by De Leuw, Cather and Company, Los Angeles, October 21, 1975.

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3. Transportation Energy Conservation and Demand, Transportation Research Record 561, Washington, D.C., 1976.

4. Transportation Programming, Economic Analysis and Evaluation of Energy Constraints, Transportation Research Record 599, Washington, D.C., 1976.

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6. J. P. Curry, Case Studies of Transit Energy and Air Pollution, De Leuw, Cather and Company, May, 1976.

NOISE AND VIBRATION

The Red Line Extension passes through highly urbanized areas, including commercial, residential and industrial land uses. Noise levels in these areas can vary significantly from place to place depending on the amount of noise producing activities in the area. The dominant noise producing activity in urban areas is vehicular traffic on streets. Trucks, buses and motorcycles set the maximum noise levels and cars contribute significantly to average noise levels. Some locations in urban areas are exposed to noise from sources such as railroad, rapid transit, aircraft, and industry, as well as the ever-present street traffic. This section describes the general character of noise levels in the areas through which the Red Line Extension will pass at present without the transit and in the future with the transit. Noise and vibration criteria is included in Appendix D.

Detailed descriptions of measured ambient noise levels are included along with the segment-by-segment analyses.

Existing Noise and Vibration

Daytime average noise levels are high in locations with commercial activity (Harvard Square, Porter Square, Davis Square, Arlington Center) and with traffic arterials (Massachusetts Avenue along entire line, Route 2 near Alewife and East Arlington, Mystic Avenue and Pleasant Street in Arlington Center). Average noise levels (hourly equivalent sound levels) associated with such areas range from 65dBA to 75dBA during daytime hours. Throughout the area, traffic can be identified as the major controller of the noise environment. In some locations such as Davis Square and East Arlington, the noise and vibrations from freight trains can be identified as an existing problem although occurrences are infrequent. Night noise diminishes by approximately 10 decibels in the above-mentioned locations due to decreased commercial and vehicular activity.

Locations away from the centers of commercial activity and away from the major streets and arterials have lower noise levels during both day and night. Daytime average noise levels (hourly equivalent sound levels) range from 55dBA to 65dBA with night levels about 10 decibels less. These levels are caused by neighborhood noise such as sounds from children playing, dogs barking, lawn mowers and passing cars or trucks on the neighborhood street, or airplanes overhead. At night, when outdoor activity decreases, noise levels in such neighborhoods continue to be dominated by passing vehicles.

Vibrations of buildings are seldom experienced in much of the area near the proposed Red Line Extension. In those few locations where a problem of vibration exists, the source of the vibrations can be traced to existing railroad operations (East Arlington and Davis Square), heavy truck, bus and trolley operations on rough streets (along Massachusetts Avenue) and internally generated vibrations from building mechanical equipment. Residents in East Arlington and Davis Square currently experience vibrations from passing trains for a number of reasons including proximity of homes to the track (within 100 feet), condition of track and trackbed, and weight of train (heavy freight locomotives and cars).

Future Noise and Vibration with Rapid Transit in Operation

The introduction of rapid transit operations in an area often results in a new source of noise and vibrations for many people. Vibrations could be a problem in residences within 100 feet of the track centerline, especially in the homes near Porter Square in Cambridge and Davis Square in Somerville under which the subway tunnel is expected to pass, and in the East and Central Arlington homes adjacent to the track. Without special vibration control features, rumbling noise may be heard at night in these homes. During the daytime hours this rumbling noise will probably be masked by noises from a variety of indoor activities, including radio, hi-fi and television playing, water running, dishwasher operating, etc.

Noise from transit operations will, in general, not add significantly to the existing noise in much of the region, with possible exceptions being near ventilation shafts and near at-grade and in-cut operations. Rather than transit operations, secondary effects of construction activities will probably have greater noise impact on the region, especially in residential areas away from commercial centers.

Noise and Vibration Control Measures

The transmission of vibrations to nearby buildings from the passage of a train in a subway tunnel involves the three elements common to most noise control problems: source, a transmission path, and a receiver. Solution of these problems requires abatement methods at one or a combination of elements.

Noise control at the receiver is not an effective solution in this situation, because it involves property takings at worst, or expensive modifications to the buildings at best: therefore, efforts

to control noise and vibration from subway train passages should be concentrated on the other two elements, the source and the path, which can be accomplished on MBTA property.

The major source of noise and vibration during the passage of a subway train in a tunnel is the fluctuating force at each wheel and rail contact point. Such fluctuating forces arise from small scale roughness on the wheel and rail and from the wheels not being perfectly round and the rails not being perfectly flat. Reduction of the combined roughness of the wheels and the rail substantially reduces the vibration level at the wheel/rail interface. An example of this type of improvement is the use of continuously welded rail rather than jointed rail: noise and vibration levels near smoothly welded rail can be 4 to 8dB lower than levels near bolted rail (Remington, 1974). Reduction of noise and vibration associated with the roughness of the wheels and rails can be obtained by grinding the rails and truing the wheels. A nine decibel reduction of the noise level was measured for the BART system after rail grinding (Wilson, 1972). Although many transit systems true wheels only when they are excessively out of round, and ground rails only when they are first installed or when corrugations develop, a continuous program of wheel truing and rail grinding when wheel and rail roughness exceed specified limits could result in measurable noise reduction. However, such a maintenance-dependent program for noise control cannot alone solve the entire problem. Noise control must be built into the system itself.

The most effective place to concentrate on noise and vibration control is therefore in the vibration transmission paths between the source and the receiver. Several techniques to do so have been incorporated into new subway systems in North America and Europe. In general, the idea is to introduce a resilient isolator somewhere in the transmission path. Two common techniques are in use: compliant resilient rail fasteners and floating slab track beds.

Resilient Rail Fasteners:

To be effective in reducing noise and vibration levels in buildings adjacent to a subway, resilient rail fasteners should have a stiffness of 100,000 lb/in. or less. This stiffness should be measured for small deflections when the fastener is under the nominal wheel load. Fasteners with a stiffness of 100,000 lb/in. can be expected to provide noise reduction of 3 to 6 decibels at low frequencies (4 to 31.5Hz) and 6 to 10 decibels at higher frequencies (greater than 31.5 Hz) when compared to direct fixation to wood ties embedded in a concrete invert (Paolillo, 1973;

Toronto Transit Commission, 1967). Rail fasteners with greater stiffness, such as 400,000 or 500,000 lb/in., have negligible effect in the reduction of noise and vibration.

Floating Slab Track Beds

The concept of a floating slab track bed involves the provision of a resiliently supported inertia mass between the rail and the tunnel invert. A cross section of a subway tunnel structure with a floating slab is shown in Figure II-2. At low frequencies (up to about 100 Hz), the slab behaves like a single-degree-of-freedom vibration isolation system (Manning, Cann and Fredberg, 1974). Below its natural frequency, the slab provides no attenuation; at its natural frequency there may be a slight increase in the tunnel vibration level; and above its natural frequency, it can provide up to 20dB of attenuation at these higher frequencies. Slabs are usually designed to have a natural frequency in the 8 to 16 Hz range, so that attenuation is provided in the audible frequency range. Some attenuation below the natural frequency of the slab, when compared to direct fixation to wood ties embedded in the invert, can also be obtained if compliant resilient rail fasteners are used with the slab.

Variations to the basic floating slab can be found in several systems. One variation, which has the advantage that it can be easily removed for servicing the resilient pads, is a resliently supported double tie. This type of inertia block isolation has been used in Germany (Stuber, 1974) and is being installed in Toronto (Wilson and Murray, 1974). Other variations of the basic floating slab are:

1. A slab tested in Stockholm which has a layer of damping material in a horizontal plane halfway between its top and bottom (see U.S. Patent #3790078).

2. Separate slabs for each rail joined by polyurethane ties used in Vienna (Hanson, 1974).

An intermediate solution between a floating slab type of isolation and resilient rail fasteners is the STEDEF resiliently isolated single ties (R.A.T.P., 1971). These ties provide approximately 8 to 12 decibels of noise reduction.

In at least one case, installation of a floating slab proved to be ineffective in reducing vibrations transmitted to the tunnel invert (Bender, Kurze and Ungar, 1969). The measured ineffectiveness is believed to be due to a combination of lack of damping, excessively stiff isolation pads, and a possible mechanical short circuit in the vibration transmission path.

One very important parameter which is frequently neglected is the effect of the tunnel wall thickness. Isolation pads provide no isolation if the walls of a tunnel are less stiff than the pads. Under such circumstances, it is more beneficial to increase the tunnel wall thickness than to install a floating slab. Recent measurements in Germany show that doubling the tunnel wall thickness can provide up to 12 to 18dB reduction in the wall vibration level (Stuber, 1974; Kock, 1974).

Extent of Noise and Vibration Control Required for the Red Line Extension

Sections in Subway

Noise and vibration problems in buildings near subways can show up in two forms: "feelable" vibrations of floors and walls and audible "rumbling" sounds during each passage of the subway train. These problems can be solved through a combination of design and maintenance of the new track sections.

In this section, the term "vibration control" is used to refer to the problem of feelable vibrations from train passages in buildings near subway sections, and the term "noise control" to refer to the problem of audible sound from train passages in the same buildings. The vibration control problem is in the 4 to 31.5 Hz frequency range, the noise control problem is in the 31.5 to 250 Hz frequency range.

Solution of the vibration control problem is more straightforward than the noise control problem. Measurements on the Toronto Subway System show that vibration levels at the tunnel invert can be reduced to below the threshold of vibration perception by using welded rail and resilient rail fasteners with a vertical stiffness of approximately 100,000 lb/in. (Wilson and Murray, 1974). Figure II-14 shows that the vibration acceleration levels of the tunnel invert measured in Toronto are below the threshold of vibration perception for frequencies less than 31.5 Hz. Resilient rail fasteners with a stiffness of approximately 100,000 lb/in. should be used for the entire length of the proposed extension, including any portions of the present tunnels which may be rebuilt. Softer fasteners should be considered if a proven design which satisfies stability constraints becomes available.

The noise control problem in subway sections requires more detailed consideration than the vibration control problem. The Red Line Extension area contains many buildings where low interior noise levels should be maintained.

Whichever noise control treatment is used in the subway should extend at least 100 feet beyond the site to be protected. For the above reason and because of the large number of sensitive sites along the proposed extension alignments, noise control treatments should be considered for the entire length of any new tunnel in the study area. Treatments which provide the equivalent noise control of floating slab track beds or resiliently isolated double ties should be used to solve the noise control problem. It is very important that a study be conducted to ensure that the tunnel wall stiffness is such that it properly supports a floating slab or isolated double ties. If the tunnel floor is so thin that its stiffness is comparable to the stiffness of the isolation pads, floating slabs or resiliently supported double ties will provide little or no noise reduction in nearby buildings. Data shown in Figure II-14 provides evidence that properly designed and constructed resiliently supported double ties can reduce tunnel wall vibration levels low enough to satisfy the noise criteria in all nearby buildings.

The proposed project for the Red Line Extension incorporates sharp radius curves at Harvard Square (250'R, 400'R) at Davis Square (700'R), and at Alewife (400'R). Wheel squeal will be almost certain at Harvard Square Station and will be a distinct possibility at all curves with radii less than 750'. This particularly annoying noise results when a wheel slips sideways on the rail and is excited at one or more of its natural frequencies (Remington, et al., 1974). Over the years, several techniques have been tried to reduce wheel squeal. For example, lubricating the rails works to some extent, but this may cause wheels to slide at stops, resulting in wheel flats, thereby causing another noise problem. In the long run, switching from standard wheels to resilient or damped wheels can be more effective in abating wheel squeal. Resilient or damped wheels may, however, be incompatible with the present MBTA cars. A third alternative, localized treatment of tunnel walls with sound absorptive materials, can be expected to lower the noise levels caused by wheel squeal by approximately 10dBA in the cars and in stations near such curves. For the proposed extension, it is recommended that tunnel sections with curves of radius less than 750 feet be treated with acoustically absorptive materials.

Using welded rail instead of bolted rail will lower noise levels by 4 to 8 dBA. However, the welding must be very smooth, which is attainable in the field only through a program of strict inspection and quality control. Otherwise, field-welded rail shows no improvement over good bolted rail.

Station Noise Control

If a new station is built, noise control measures will be taken to ensure that the station has the proper acoustical environment. With care and proper design, the peak noise levels for trains entering stations can be held to approximately 75dBA (see Appendix D). One major reason for high noise levels in older stations is the hard surfaces (walls, ceilings and platforms) that reflect the sound. To lower noise levels in stations, sound absorbing surfaces must be introduced. The two best sound absorbing surfaces are the station ceiling and the area under the platform overhang. The ceiling is good because it offers a large surface and because it is not subject to wear or vandalism. Treatment to these surfaces can be expected to lower noise level by approximately 10 decibels (Bender, Hirtle, Malme and Stern, 1973).

Noise Control Implementation

In design development phases, noise and vibration consultants will be under contract to assist the tunnel and station designers. Additional noise and vibration measurements will be made and comprehensive geo-technical information will be available. As the characteristics of the subway's alignment, profile, ventilation systems, station design and other components become more definitive, the designers will be enabled to recommend specific applications for control of airborne noise and groundborne noise and vibration.

One or more of the noise control methods discussed will be employed in the design to achieve the criteria set forth in Appendix D. Permanent noise control will be established by design. Short term construction noise will be controlled by criteria incorporated in the construction contracts and compliance will be a legal responsibility of each construction contractor.

ECOLOGY

The high degree of urbanization in the project area has resulted in the exclusion of most naturally functioning ecosystems. Few tracts of high quality native vegetation still exist. Most plant life consists of ornamental shrubs and trees around homes and buildings; highly disturbed, "weedy" plant species along transportation rights-of-way, or small, abandoned plots. The acquatic drainage systems in the region have been subjected to major alterations and have received polluted effluents from industrial and municipal sources. Consequently, analysis of natural ecological factors has been focused on those few areas where natural phenomena dominate. These areas include: Alewife Brook and the associated wetlands; Spy Pond and the adjacent railroad right-of-way; and Mill Brook. The other areas, which were considered in the earlier BTPR study, have been eliminated from further analysis because of their peripheral location to the project or they are considered in the Section 4(f) Statement.

The study approach and impact assessment included a review of the existing literature, field inspections, and contracts with State and Federal environmental agencies, local conservation commissions, university personnel, and other knowledgeable persons. Because of the severity of probable impacts and the ecological importance of the Alewife wetlands, and in-depth investigation was made in this area.

The largest tract of natural open space in the study corridor is the land along the Little River, located generally west of the proposed station. The area potentially affected by the Red Line is the roughly triangular tract, bounded by Route 2, the Dewey and Almy Circle, the Freight Cutoff and Little Pond. See Figure VI-11. The natural areas in this tract have diverse plant communities which furnish valuable wildlife habitat; they also provide potential storage capacity for storm water runoff, and, because of their wetlands characteristics and juxtaposition with the urban setting, afford other ecological benefits for the total environment.

A full description of the soils, geology, hydrology and biological features of this area and possible impacts from the project is included in Chapter VI.

The East Arlington area, while having some commercial and industrial development and a few major thoroughfares which are primarily outside the immediate study area, is characterized by single and multiple family dwellings. Within this setting, small areas of open space offer marginal habitat for certain wildlife species. A few small

mammals, such as cottontail rabbits, are occasionally found, but the area's wildlife primarily consists of songbirds. Starlings and house sparrows, typical of urban environments, are abundant but many other esthetically pleasing species are also present.

Along the study corridor, the major natural environmental resources are the Lexington Branch railroad right-of-way coupled with the adjacent residential backyards and Spy Pond. A full description of these areas and possible impacts is contain in Chapter VII.

Mill Brook is a unique physical feature which has historical and recreational significance for the Town of Arlington and passes through the center of the Town. Although it has been modified by urban development, it also offers a natural riparian environment of some ecological merit, particularly at the western end of the section. Chapter VIII contains a description of the relationship of the brook and the project.

SECTION 4(f) STATEMENT

In a regional context, the Red Line Corridor contains a variety of open spaces, public parklands, recreational areas and historic resources which serve the needs of a large urban population. Because of their important contribution to the quality of life in the total environment, careful attention has been given to the relationship between these resources and the transit alternatives. These environmental concerns are brought into focus by the legal requirements of the National Environmental Policy Act (NEPA) of 1969 and Section 4(f) of the Department of Transportation (DOT) Act of 1966, as amended and Section 106 of the Historic Preservation Act.

Section 102 of the NEPA requires the preparation of a detailed Environmental Impact Statement which includes a description of the environmental impact, unavoidable adverse effects, alternatives, and irreversible commitments of resources for "major Federal actions significantly affecting the quality of the human environment.

Section 4(f) of the DOT Transportation Act of 1966 is intended to result in a comprehensive evaluation of all environmental impacts involved in Federal-aid transportation projects that require the use of public parklands, recreation areas, wildlife and waterfowl refuges, and public or privately owned historic properties of Federal, State or local significance. This evaluation is referred to as a Section 4(f) report. The report must be sufficiently detailed to permit the U. S. Secretary of Transportation to determine that:

- There is no feasible and prudent alternative to the use of such land, including the no-build option.

- The program includes all possible planning to minimize harm to any park, recreation area, wildlife and waterfowl refuge, or historic site resulting from the use of such lands.

- If there is no feasible and prudent alternative, the proposed project must include all possible planning to minimize harm to the affected lands.

As a consequence of the legal constraints and framework, an initial inventory of all potential 4(f) lands or structures was performed. Our review shows that some of these properties are definitely 4(f) lands and for others, their 4(f) status is not clear. Sources of information included the BTPR Red Book; available Metropolitan District Commission and municipal documents such as open space/recreation plans; and contacts with park commissions, municipal planners, historic commissions, and other knowledgeable persons.

To further assist in the collection and analysis of data, letters requesting a determination of significance were sent to the agencies or people having jurisdiction over the potential 4(f) lands. These letters requested specific items of information to substantiate a declaration as well as the determination per se.

This initial inventory of actual or potential 4(f) lands was followed by an analysis of impacts resulting from the proposed project. Both long-term and short-term impacts were considered, as were the impacts of alternatives to the project.

Careful attention was given to historical 4(f) resources since the Red Line Corridor has an extraordinarily high proportion of sites, structures and districts that are historic or have architectural distinction. The term historic resources refers to sites, structures or districts of historic, architectural or archeological significance. There are several levels of official recognition granted to these resources. The U. S. Department of the Interior maintains a "National Register of Historic Places" which lists historically important national, state and local resources. A few are of particular national importance, and are selected for additional distinction by being named National Historic Landmarks.

Project Description

The project is a 6.5 mile extension of the MBTA Red Line Rapid Transit from the present terminus at Harvard Square to Arlington Heights in the town of Arlington, Massachusetts.

The length of each line segment and station area as well as the proposed method of construction are summarized in Table S-1. From a cut-and-cover segment through Harvard Square, the route proceeds north in tunnel/deep bore, generally following Massachusetts Avenue to Davis Square in Somerville. The route then turns west in a tunnel/cut-and-cover on the Freight Cutoff to Alewife just south of the Dewey and Almy Circle where Route 2 from the west terminates at the Alewife Brook Parkway. The route proceeds in tunnel cut/and cover north and west from Alewife along the Lexington Branch of the MBTA Commuter Rail System to Arlington Heights.

The Harvard Square Station would be rebuilt in a new location and new stations would be constructed at five other locations studied in detail in this report. These are: Porter Square in Cambridge, Davis Square in Somerville, Alewife in Cambridge, Arlington Center and Arlington Heights in Arlington. A separate chapter is devoted to each of these station areas. Parking spaces for 2,000 vehicles would be provided at Alewife and 350 at Arlington Heights. No new parking would be provided at Harvard, Porter or Davis Squares, or Arlington Center.

The alignment and station locations are shown on Figures II-1A through E.

Permanent vs. Construction Impacts

No permanent taking of 4(f) lands is anticipated for the construction of the Red Line Extension. There will be, however, several requirements for underground easements. There will be some temporary takings during construction; these takings would be minor, usually a narrow strip of land and some trees and plantings. Other construction impacts would result from construction noise, dust and dirt, and security and safety problems. The effect of these impacts can be reduced through mitigating measures.

Each 4(f) area is discussed, describing the existing lands, facilities, use and patronage. The probable construction impacts are described and mitigating measures are suggested which would provide for maintenance of recreational functions and protect the structure and character of historic resources during the construction. Plans are currently underway to have an archeologist perform a preliminary archeological reconnaissance study of the project alignment. An archeologist will also be available in accordance with Massachusetts law throughout the construction process to make site investigations. He would identify artifacts of potential archeological value so that actions could be taken for appropriate salvage operations under the direction of qualified professionals. All such activities would be coordinated with the Massachusetts Historical Commission.

Evidence of No Feasible or Prudent Alternative to the Transit Alignment and Station Locations

The project definition of the Red Line Extension has evolved from a complex of previous studies, policy decisions, cooperative agreements and community participation. At each step in this planning process, a different range of alternatives has been examined at an increasingly discriminating level of detail. The BTPR Red Book and Chapter IX of this document contain a detailed history of alternative transit programs for the region. The selected alignment follows existing transportation rights-of-way to avoid the greatest numbers of properties, recreational facilities and historic resources; construction impacts have also been kept to a minimum by this alignment.

Within the context of the extensively developed manmade environment of the study corridor and the existing social, cultural and physical constraints, no prudent and feasible alternatives exist for avoiding all impacts to 4(f) properties. The details of the relationship between the specifics of the construction process and geometric design of the project and the affected 4(f) properties are summarized here and discussed in even more detail in the chapters pertaining to the station area or line segment along which the properties are located. The mitigating measures necessary to afford maximum protection to these important resources are described in this section.

There are certain impacts which cannot be fully anticipated nor mitigated until the final design process. To foster appropriate protective measures for these important resources, a process has been established in each case whereby cooperation between the MBTA and the local responsible agencies will achieve this objective.

The following analysis begins in Harvard Square and considers potential 4(f) resources in the sequence in which they occur along the alignment as it continues north and west through Arlington.

Based upon this analysis, it is the determination of the Urban Mass Transportation Administration that there are no feasible and prudent alternatives to the use of these 4(f) lands and that all possible planning has been done to minimize harm to these lands.

Old Harvard Yard/Cambridge Common/Old Cambridge Historic Districts

The proposed project would be within and near three overlapping historic districts in the Harvard Square area. Two of these districts, designated "Old Harvard Yard" and the "Cambridge Common Historic District" are listed in the National Register of Historic Places. The other district, "Old Cambridge Historic District", is the locally designated district. It contains both federally designated districts and additional sections of Cambridge. It has been accepted by the Massachusetts Historical Commission.

Detailed documentation of the project's relationship and potential impacts to the Old Harvard Yard and Cambridge Common Historical District are contained in the 106 Case Study Report which is Appendix G to this EIS. Separate documentation for the Old Cambridge Historical District has not been prepared since the portion of the District within the Project is contained in the two National Register Districts. For the purpose of fulfilling the requirements of Section 4(f), the 106 Case Study has been reproduced verbatim and included in this 4(f) Statement.

Description and Use

Old Harvard Yard District

The following description is taken from the National Register Nomination Form:

> The district designated as Old Harvard Yard consists of a large, tree-shaded, roughly rectangular open space and smaller peripheral spaces to the west and south. Adjoining on the east are portions of Harvard Yard that developed after the designated district, achieving their present character in the twentieth century. The Old Yard's spaces are defined by freestanding buildings, most of which are

three or four stories high and built of brick. The oldest building, Massachusetts Hall, dates from 1718; the other buildings that help define the principal space were built over the succeeding century and a half. The only twentieth century buildings, all of which are compatibly neo-Georgian in style, are on the periphery of the district, walling it off from surrounding traffic noise.

All the Old Yard's buildings are (or were built as) dormitories or academic buildings except Wadsworth House, a two-story, gambrel-roofed wooden dwelling built in 1726 as an official residence for Harvard presidents and used as such until 1849. Nearly all the Old Yard's buildings have been remodeled on the inside, but their exterior integrity remains intact.

Cambridge Common Historic District

The following description is taken from the National Register Nomination Form:

> The Cambridge Common Historic District includes the Cambridge Common, streets bordering the Common including Massachusetts Avenue, Peabody Street, Garden Street, and Waterhouse Street, and the surrounding land and buildings to a depth of about 100 feet back from the streets. The boundary line is deeper on the Peabody Street side to include Harvard buildings in the oldest part of the Yard, and on the Massachusetts Avenue-Garden Street corner to include the Old Burying Ground and Christ Church.
>
> In addition to the Common, the District contains the following important properties: First Church, Unitarian (1833, Isaiah Rogers), a wooden Gothic Revival church, the exterior of which is in original condition except for the absence of finials around the spire; the Old Burying Ground (1635), a wooded lot of uneven terrain containing over 80 17th century stones and the 1734 milestone "8 Miles to Boston;" Christ Church (1760, Peter Harrison), a simple wooden building with arched windows and a Doric frieze, intact with the exception of two bays that were added in 1857 to lengthen the building; 1 Garden Street (1820, William Saunders), a wooden Federal-style house in good condition; Fay House (1806) in the Radcliffe College Yard, a brick Federal-style mansion rebuilt for college purposes in 1890 (Longfellow, Alden & Harlow); First Church, Congregational (1870), Abel C. Martin), a trap-rock church trimmed in granite and brownstone; 7 Waterhouse Street (c. 1753), originally a three-bay wooden house with later additions of the two right-hand bays and entrance porch; Harvard-Epworth Methodist Church (1891,

A. P. Cutting), a Richardsonian stone church; Gannett House (1838), a Greek Revival house with full four-column portico; and Harvard buildings including Stoughton Hall (1804, Charles Bulfinch, architect, Thomas Dawes, master builder), Harvard Hall (1764, Governor Francis Bernard, designer, Thomas Dawes, master builder), Massachusetts Hall (1718), all brick buildings of early, middle, and late Georgian design.

The Cambridge Common itself represents the remaining portion of the common lands, orginally extending north to Linnaean Street and beyond, set aside for cow pastures and public meetings, with the part nearest Harvard Square used occasionally for military drill. The "Path" from Charlestown to Watertown which crossed the Common from Kirkland to Mason Streets was the first way to the west in the Massachusetts colony and followed an earlier Indian trail.

The Common was diminished in 1724 when the northern portion was subdivided into parcels and the north boundary was moved back from Linnaean Street to Waterhouse Street, a decrease from 86 to about 16 acres. Roadways divided the area, but houses and shops were soon built around the new boundary and a row of elms was planted c. 1700 along Garden Street so that the limits of the Common were defined and the space enclosed. This sense of enclosure was reinforced by Christ Church, a schoolhouse, and other buildings after 1760. A boundary adjustment occurred at this time when a lot of the common lands was purchased by founders of Christ Church to add to their building lot and another strip of land from the common lands was added to the Burying Ground to straighten the boundary. The Proprietors of the common lands conveyed the Common to the city in 1769 for use as a training field, in apparent anticipation of coming hostilities.

During the Revolution, the Common was the headquarters of the Continental Army, with barracks for the soldiers located in the west corner. Afterwards the Common was still an open field of uneven topography with narrow roads crossing the area. After construction of the West Boston Bridge in 1792 and the Craigie Bridge in 1809, the area became a busier intersection of the trade routes linking Boston with the west, Massachusetts Avenue, the Concord Turnpike, and Mason-Brattle Streets.

In the 19th century, the Common began to take on its present appearance. In 1830, under special legislative authority and direction of a commission, a group of citizens was permitted to enclose the main Common by a granite post and wood rail fence as at present, diverting the

roads then crossing it, and to plant trees. An attempt was made by the county the following year to reopen the direct route west, but was denied in a court case so that the Common remained closed to traffic. At this time many of the remaining building sites around the Common were filled, and the sense of enclosure increased.

In the mid-19th century, crosswalks were laid out and trees were planted along the walks and around the edge of the Common, and the path system began to take on its present form. The park assumed a ceremonial air with the addition of Soldier's Monument in 1869, three Revolutionary War cannon in 1875, the scion of the Washington Elm in 1876, the John Bridge Statue in 1882, and several granite markers at historic sites. The Common became a recreational area as well when baseball was introduced in the west corner in the second half of the 19th century. Additional park area was created when a part of Massachusetts Avenue at the north corner was enclosed and landscaped some time after City Council approved plans in 1858. The area, sometimes called the North Little Common, remains a well-protected and well-maintained green space in the district.

The three small areas of the Common changed considerably in the early 20th century. The installation of the subway ramp in 1909-1912 cut up the Little Common between Massachusetts Avenue and Peabody Street (plots 2 and 3 in the 1830 survey) and Flagstaff Park was created in 1913 to improve the surface. The Holmes lot was traded to Harvard in 1929 in exchange for the lot of the present Central Fire Station.

Presently the Common is in need of renovation, particularly new landscaping and improvement of the path system. Such renovations are being proposed with a 1975 completion date. Improvements may change the appearance of the Common, but any alterations will be in keeping with the historic site as required by the Cambridge Historical Commission Ordinance of 1963.

The Cambridge Common has been the focal point of political, religious, and social activity in Cambridge for well over 300 years. Set aside for grazing in 1631, the Common became the location of annual elections for the governor of the colony in 1636, and the site of George Whitefield's controversial sermons in 1740. The Common was the center for rebellious activity in the years preceding the Revolution, and the main camp of George Washington's Continental Army in 1775-76, with barracks in the west corner. In the early 19th century, the Common was significant as the intersection of major trade routes through Cambridge, and

in 1830 as an early example of dedication, enclosure, and improvement as a public park.

Several significant buildings and sites surround the Common. Architecture of major 18th and 19th century styles are represented by a church, a house, and four college buildings of the Georgian period, two important Federal-style houses, a Greek Revival house with elaborate detail, a Gothic Revival church, and two masonry churches of the Queen Anne period. These buildings are historically significant as well: First Church, Unitarian was built for the Unitarian branch of the First Church in Cambridge after the congregation split in 1829 and the new branch abandoned the 1756 meeting house in Harvard Square; the Old Burying Ground which replaced Cambridge's first cemetary contains the graves of Revolutionary soldiers, Harvard presidents, and other early Cambridge citizens; Christ Church (National Historic Landmark), the city's oldest surviving religious structure, was founded by Tories who fled at the outbreak of the Revolution during which troops occupied the building; 1 Garden Street was designed and occupied by William Saunders, a master builder responsible for many Federal-style and Greek Revival houses in Cambridge; 7 Waterhouse Street was the home of Dr. Benjamin Waterhouse, the scientist who made the use of smallpox vaccine acceptable and popular in the United States; Holden Chapel, the gift of the widow of an English Dissenter, introduced English taste in architecture to Cambridge; Harvard Hall was built by the state to replace the second Harvard Hall which burned when the General Court was meeting there; Massachusetts Hall (declared eligible for the National Historic Landmark status, but not yet accepted), Harvard's oldest existing building, was used along with Hollis Hall as barracks for colonial troops during the Revolution. Adjacent to the Common at the west end of the present Littauer Center is the site of the Hastings-Holmes house which served as the meeting place for the Committee of Public Safety and the headquarters of General Artemus Ward during the Revolutionary period, and was the birthplace and home of Oliver Wendell Holmes, Sr. and Jr., in the 19th century.

The significance of the Cambridge Common Historic District is great: the area contains important landmarks of Cambridge's history; the Common and surrounding buildings represent a 340 year evolution of an area from an open field to an enclosed park in a dense setting; the Historic District itself, established in 1963, demonstrates current efforts by a city to maintain an important historic area.

The boundaries of the National Register Districts described above are indicated on EXHIBIT E.

It is recognized that all significant structures and features within or surrounding a National Register District share equal status with respect to the 106 review process and the impacts on these as a collective entity are reviewed in discussions that will follow. Of the numerous buildings and sites in the National Register Districts and contiguous areas, several will be more sensitive to possible impacts than will others due to close proximity to the project area and these are singled out in the following list. A capsule description and evaluation of importance is included. (Source: "Evaluation of Buildings and Sites Within the Area Surveyed for MBTA Realignment in Harvard Square", August 9, 1974 by the Cambridge Historical Commission) EXHIBIT F indicates the location of these buildings.

1. Harvard Yard

Massachusetts Hall, 1718 (National Historic Landmark)

Primary Importance
Harvard's oldest building
Prototype of 18c. college hall in New England
Essential element of Yard

Wadsworth House, 1726

Primary Importance
Fine early 18c. house, though modified
Residence of Harvard presidents, 1726-1849; only reminder of 18c. directly visible from Mass. Avenue

Holden Chapel, 1742

Primary Importance
Essential element of Yard

Harvard Hall, 19764, enlarged 1842, 1870

Primary Importance
First college building in America entirely devoted to academic (non-dormitory) uses
Excellent Georgian II architecture enchanced by three remodelings
Essential element of Yard

Lehman Hall, 1924: Coolidge, Shepley, Bulfinch, Abbott

Primary Importance
Essential to scale and privacy of Yard; visually dominates and defines space of Harvard Square

Lionel and Mower Halls, 1925: Collidge, Shepley, Bulfinch, Abbott

Primary Importance
Essential elemnts of Yard

Straus Hall, 1925: Coolidge, Shepley, Bulfinch, Abbott

Primary Importance
Essential to scale and privacy of Yard

Memorial fence and all gates, 1899 ff: McKim, Mead and White
(Partly in National Register District)

Primary Importance
Essential to unity and privacy of Yard

2. Harvard Square Area

First Parish Church Unitarian, 1833: Isaiah Rogers

Primary Importance
Fifth meeting house erected by congregation; a Cambridge landmark
Though stripped of ornamentation, still represents Gothic Revival

3. Cambridge Common Area

Cambridge Common, 1631

Primary Importance
Many historical associations

Old Burying Ground, 1635

Primary Importance
Many historical associations

Gannett House, 1838

Moderate Importance
Example of Greek Revival temple house
Poorly related to Common and to other buildings in North Yard

Hastings Hall, 1888: Cabot and Chandler

Important
Good example of Medieval Revival style
Creates spatial definition on one side of Common

Harvard Epworth Methodist Church, 1891: A. P. Cutting

Important
Moderately good example of Richardson Romanesque

A building not rated in the aforementioned evaluation by the CHC is Hemmenway Gym, 1938, which is within the Cambridge Common Historic District and close to the undertaking.

An important feature outside of but contiguous with the Old Harvard Yard National Register District is the existing main entrance to the subway in Harvard Square. The CHC evaluates the structure as follows:

Subway Kiosk, 1928: architect unknown

Very Important
Sound design and massing, excellent scale presently obscured by signs and poles
Essential element of Harvard Square, with important symbolic associations.

DESCRIPTION OF THE UNDERTAKING IN THE HARVARD SQUARE AREA

A. Existing Conditions

At the present time Harvard Square is a terminus point of the subway. The underground station here consists of two-level rapid transit platforms on the east side of the square and two-level busway platforms on the west side. The several platform areas are interconnected by a complex of pedestrian passageways, and a mezzanine directly under the square.

Components of the facility observable at street level include several entrance-exitways to the subway, and an open busway incline in Flagstaff Park where electrically powered busses enter and leave the station's underground bus tunnels. The main point of pedestrian access to the station is at the traffic island in the middle of the Square. Here, stairways to the subway are protected by a low, rectangular kiosk of masonry and glass with a wide overhanging roof delicately framed of metal arched ribs and copper roofing. The island space is shared with an adjacent, active newsstand business housed in a separate structure of undistinguished character.

Another protected stair, small in scale, is located near Lehman Hall and, as an integral element of the Harvard Yard fence, is relatively inconspicuous. A similar stair occurs near Wadsworth House and a small entrance is located on the south sidewalk of Massachusetts Avenue near Holyoke Street, but has been closed for public use.

Four brass placques are located in the pavement of Massachusetts Avenue opposite Wadsworth House. These placques mark the locations

of two 17th century houses, the foundations of which were discovered when the subway was constructed.

The busway incline bisects Flagstaff Park. Substantial, relatively high parapet walls guard the open sides of the two-lane ramp. Park space west of the incline has been paved for public parking but is semi-concealed by a fence and planting. The space on the east is generally verdant with liberal plantings of trees, shrubs and grass which effectively camouflage the busway. A flagpole of monumental character is situated in this section of the park. Above the tunnel portal is a formal paved terrace backed by an ornamental masonry wall. A pedestal-mounted statue of General Sumner occupies the center of the terrace and faces Harvard Square. The locations of the existing surface elements discussed above are shown on EXHIBIT F.

B. Proposed Undertaking

The almost right angle turn of Massachusetts Avenue northward at Harvard Square describes also the path of the proposed undertaking which will follow that right-of-way to the next station stop at Porter Square in Cambridge. From a point in the existing station, approximately in front of Wadsworth House, new tunnels will turn the corner, passing close to Lehman Hall, and immediately emerge into a new two level station extending toward Flagstaff Park. From the new station northward, tunnels will bend toward a straight heading up Massachusetts Avenue and continue in deep (bored) tunnels. Excavations for the tunnels and station in Harvard Square will be dug from the surface. Temporary decking will allow traffic to be maintained while the structural envelope of the tunnels and station is under construction. Thereafter the surface areas would be restored while interior work is carried to completion. Much of the work will involve the removal and rebuilding of portions of the existing station, particularly the area under the present kiosk and, in order to maintain service, it will be necessary that patrons use a temporary station to be constructed on the opposite (south) side of the present tracks and platforms. The extent of surface areas that would be disturbed by construction is shown on EXHIBIT G.

Construction of the undertaking in Harvard Square would require approximately 36 months.

EXHIBIT H indicates a preliminary concept of the new station (below ground). The space under the present kiosk will continue to be the focal point for primary access, fare collection and passenger connections between trains and buses. However the existing maze of stairs and passageways will be replaced with a spacious single-level lobby reached from the surface by a combination of new access elements including escalators, stairs and a passenger elevator as needed to meet functional and legal requirements of capacity, convenience, safety, and accessibility by the handicapped. The locations of these elements with respect to points of surface penetration in Harvard Square and at other locations in the area of the complex are tentative. Final selection will be coordinated with on-going studies of pedestrian and vehicular circulation by

the City of Cambridge. The objectives of these studies is to create a better pedestrian environment by lessening conflicts and congestion and by an allocation of open space more favorable to pedestrians. In principle, it is proposed to provide a main entrance in the general vicinity of the present kiosk, an auxilliary entrance in or toward Brattle Square, an exit or combined entrance/exit at the north end of the station and one or more peripheral entrances in Harvard Square as may be dictated by the final traffic plan.

IMPACTS AND MITIGATING MEASURES

A. Long-Term Impacts

It is probable that the proposed undertaking can be constructed and used with little, if any, permanent adverse affect on the National Register Districts, and the potential exists that some of the effects will be beneficial.

The following is a discussion of issues having impact implications on a long-term basis. The short-term impacts during construction are discussed in a separate section.

1. Noise and Vibration Impacts

Field investigations and analysis indicate that noise and vibration from train operations will cause unacceptable noise and vibration levels in nearby buildings unless suitable control measures are used.

In a report entitled "Noise and Vibration Environmental Impact of the Proposed MBTA Red Line Extension at Harvard Square", July 1975, by Bolt Beranek and Newman Inc., the following buildings of the Old Harvard Yard and Cambridge Common Historical Districts are listed as areas requiring special noise and vibration controls: "Harvard buildings along Massachusetts Avenue (Lamont Library, Wigglesworth, Wadsworth, Lehman, Strauss, Gannet, Walter Hastings), Epworth Church."

The report further shows that noise and vibration can be brought to an acceptable, non-impactive level by utilizing proven design and construction techniques. The following specific recommendations would be implemented:

a. Welded rail and resilient rail fasteners (with a stiffness of 100,000 lb/in or less) would be used in all parts of the tunnel extension as well as in all parts of the present tunnel and station which may be renovated.

b. Floating slab track beds or resiliently supported double ties would be used for all parts of the proposed tunnel with a possible exception under Flagstaff Park.

c. Sections of tunnels with curves of radius less than 750 ft would be treated with acoustically absorptive material.

2. Alterations of Property Within the Harvard Yard N. R. District

The existing, secondary stairways to/from the subway and located along and behind the fence at Lehman Hall and near Wadsworth House would have to be abandoned. As previously described these were built integrally with the fence and each consists of an opening in a panel of wrought iron pickets behind which a plain, box-like structure encloses the rear, sides and roof of the stairway landing. These are illustrated on EXHIBIT K-2.

The entrance at Lehman Hall would be removed when new tunnels are excavated (see later discussion on temporary removal of fencing) and would not be reconstructed. Instead, the affected fence panel would be rebuilt to match adjacent panels and the stairway area behind would become yard space.

Removal of the stairway near Wadsworth house is not required but it also would serve no future purpose, and a similar course of action is justifiable.

These modifications are not seen as being detrimental. The architecture of the fence and the open space behind would be unified and the original purpose for privacy would be retained.

3. Impact on the Setting

The project will not visibly change the setting of buildings and grounds within the N. R. Districts. However, contiguous street and sidewalk spaces in and around the kiosk area will be subject to modifications and thus certain aspects of the overall setting as it exists today would be affected. Modifications will be reviewed by the State Historic Preservation Officer and the Cambridge Historical Commission.

The objective is to mitigate some of the negative aspects, i.e. congestion, vehicular-pedestrian conflicts, visual clutter, and to reinforce positive qualities--Harvard Square's atmosphere of urban vitality and its identity as the focal point of the area. Construction of the subway extension provides an opportunity to initiate actions directed toward these purposes.

There are many important issues to be resolved before a concept of the streetscape in the Harvard Square Kiosk area can be finalized. It is inevitable that existing conditions would be altered but the extent of change is problematic at the present time. Examples of possible changes that may occur include:

- o modifications of traffic movements and trafficways;
- o restrictions on curbside parking in selected areas;
- o widened sidewalks and reshaped pedestrian spaces coordinated with strategically placed subway entrances;

- o improved paving and landscaping;

- o displacement, relocation, and/or renewal of existing street features such as the newsstand, information booth, kiosk, street lights, signs, poles, signals, public phones and other appurtenances.

The MBTA recognizes that the location of entrances, the design of entranceway components and other elements of the streetscape are a matter of concern to the Cambridge Historical Commission and the Massachusetts Historical Commission and it is the Authority's intention to keep all interested parties informed throughout the design development phases. The MBTA has also agreed to preserve the existing Kiosk and re-use the structure at a prominent location within Harvard Square.

One of the predictable, beneficial impacts would be a significant reduction in the number of diesel busses in Harvard Square. Several routes terminate here and are required by schedules to hold-over in the square before returning. As a result, numerous busses at times are parked end to end along the sidewalk next to Harvard Yard. These routes will be dropped or redirected to other stations along the subway extension and would no longer detract from the setting. Furthermore, another source of noise and air pollution would be eliminated.

B. Short-Term Impacts

The primary impacts of the undertaking on National Register properties are those associated with the construction phase. Some are actual and can be mitigated but not avoided. Others are potential impacts which can be prevented. The actual impacts include:

- o General disruption of the setting due to construction activity.

- o Temporary removal of portions of fencing along Lehman Hall.

- o Temporary removal of surface features in Flagstaff Park (statue, flagpole, etc.).

- o Removal of existing trees, shrubs in excavated areas prior to re-landscaping.

Potential impacts include the possibility of structural damage to certain nearby buildings during excavation.

The following discussion describes the actual and potential impacts and proposed mitigating measures.

1. Impact on the Setting

The impact affecting the National Register Districts as a whole is the effect that a major construction effort would have on the area's setting. It will be evidenced by the necessary excavation operations in

Massachusetts Avenue and Flagstaff Park (most visible and disruptive action) followed by erection of temporary roadway decking which will remain until the basic structural envelope of the subway is completed. It is anticipated that much of the surface can be fully restored well in advance of the estimated 36 months of total construction time. Existing busway tunnels will be available to bring construction materials into and out of the affected area and hence will mitigate much of the surface disruption that might otherwise occur.

Temporary traffic reroutings and parking constraints may inconvenience persons visiting the historic districts by automobile. Public transportation, however, will be maintained at present levels of service.

The Historic Districts will be exposed to construction noise and vibration but presently available quieted construction equipment would be used to reduce the impact.

Dust caused by the construction will be mitigated by the deck covering the work area and by an adequate water supply to control the dust.

2. Impact on Individual Historic Properties

a. Old Harvard Yard District

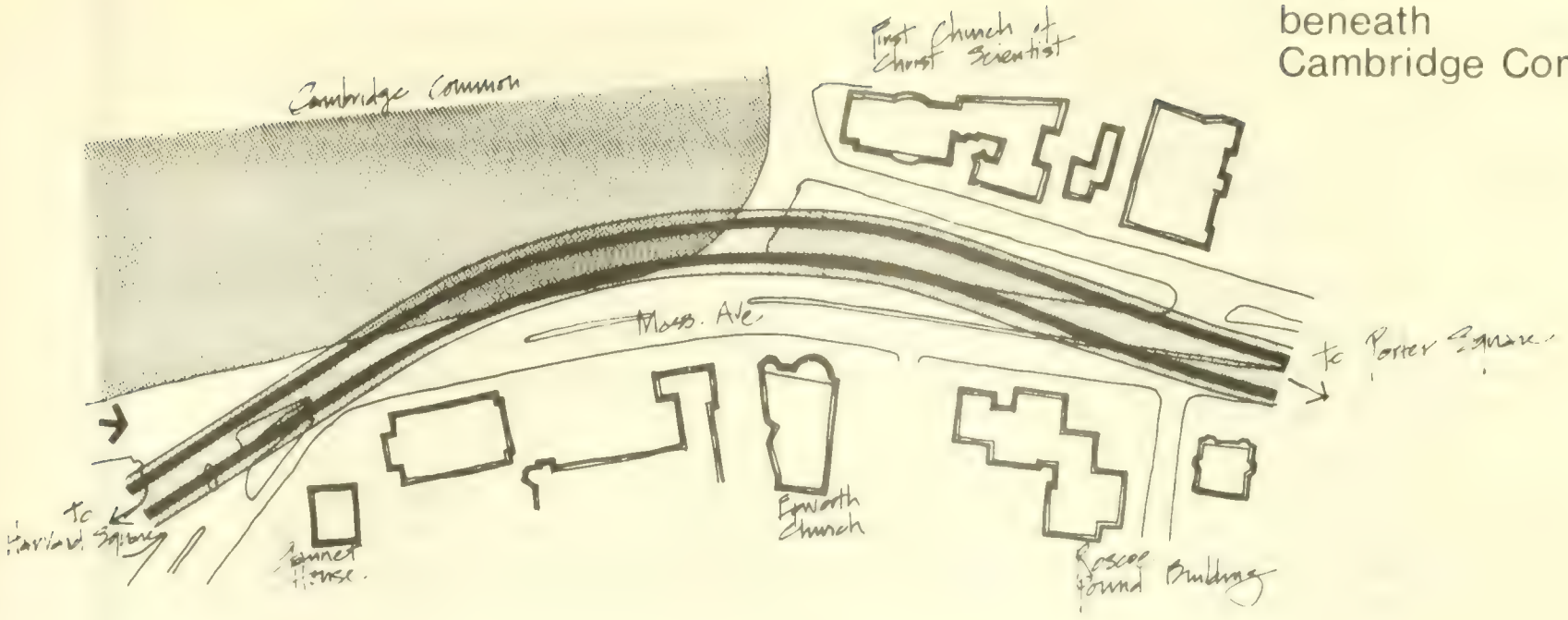
A number of buildings within the district are close to the proposed undertaking and have appreciable architectural or historic importance: Wadsworth House, Lehman Hall, Straus Hall, Massachusetts Hall, Harvard Hall, Lionel Hall, Holden Chapel and Mower Hall. Of these eight buildings, only Strauss, Lehman and Wadsworth Halls would be subject to possible construction impacts. EXHIBIT J-1 shows the relation of the proposed subway to Lehman and Straus Halls.

The alignment of the proposed tunnel would necessitate excavation from the surface along a line passing close to the aforementioned three buildings and would encroach upon a strip of yard space fronting Lehman Hall. To protect these buildings from settlement stresses, a trench-cut slurry wall is proposed which would retain and stabilize the earth behind the line of excavation. Previous experience with the slurry wall construction technique has shown that damage to adjacent buildings at best is non-existent and at worst is insignificant. The quality of workmanship would be controlled to ensure that little or no damage occurs. Approximately 250 lineal feet of masonry and iron fencing bordering the Lehman Hall site would be temporarily removed. Salvageable components such as dressed stone and ornamental iron would be catalogued and stored for re-use. The fence would be rebuilt to match the present design after primary sub-surface construction is completed. All disturbed landscaping and paving would also be renewed. A portion of the fencing that would be affected is shown on EXHIBIT K-3.

b. Cambridge Common District

None of the many important buildings in the District would be

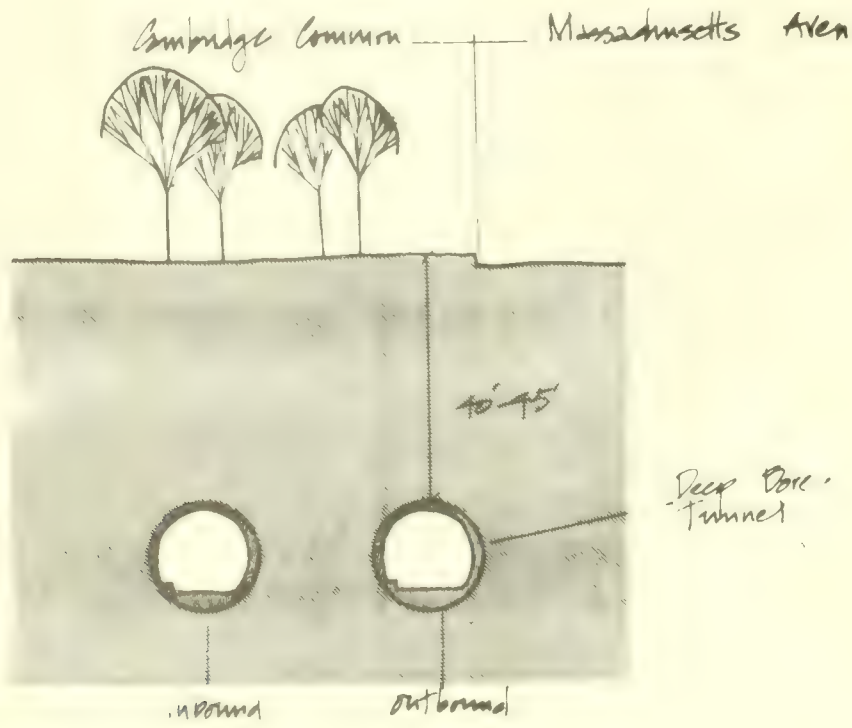
Alignment
beneath
Cambridge Common



directly affected. However, station construction in Massachusetts Avenue would occur about 30 feet away from the First Church, Unitarian and, though no adverse affects are anticipated, a monitoring program would be implemented as a precautionary measure. If monitoring data indicated that the Church building was beginning to respond to construction activity, appropriate preventative measures would be initiated to eliminate the cause. EXHIBIT J-2 shows the relation of the subway to the church.

These would be restored in their existing locations unless otherwise directed. The Cambridge and Massachusetts Historical Commissions have indicated that the wall presents a visual intrusion on the historic original Cambridge Common and consideration was given to a concept that would permanently remove the wall and possibly relocate the statue. The Advisory Council has agreed to this concept.

Tunnel Section
beneath
Cambridge Common



Construction in Flagstaff Park would require the removal of about 27 trees, mainly oaks, maples, and elms of small to medium size. The affected area would be re-landscaped with comparable plantings of trees, shrubs and grasses upon completion of construction. Temporary removals would include the flagpole, statue, paved terrace, and masonry garden walls. These would be restored.

The existing MBTA busway ramp would be re-built at approximately its present location. An existing paved parking area in Flagstaff Park would be retained unless an alternate type of surface restoration is directed by the city.

A small segment of sidewalk and lawn near Gannet House and Hemmenway Gym would be disturbed and subsequently restored. Both these buildings are sufficiently close to the construction as to require precautionary monitoring.

The deep bore tunnel posses about 40 to 50 feet from Hemenway Gym and Gannet House, at depth of about 30 feet. Both these buildings are sufficiently close to the construction as to require precautionary monitoring. This tunnel passes under the northern corner of the Cambridge Common and under the North Little Common. The top of the twin bore is 30 to 50 feet below the surface and no surface disruption should occur as a result of this work.

ALTERNATIVE ALIGNMENTS

Studies to route the existing subway through the Harvard Square area to a northward heading along Massachusetts Avenue involved examination of five possible alignments. The alignments, designated A, G-1, G-2, D-1, and D-2 are shown on EXHIBIT C. Alignment D-2 is the selected alignment of "the undertaking". These alignments were selected for study in response to a number of transit and community considerations. A commonality of all the alternatives is that alignments must pass under the Cambridge Common Historical District to reach a northward heading. There are no alignments consistent with the intent of the undertaking which could by-pass this District. Furthermore the considerable number of nationally and locally important historic properties are widely dispersed throughout the project area. It is virtually impossible for any subterranean routing not to be within a zone of influence of one or more such properties.

None of the alignments studied would, by design, permanently alter a National Register building or its setting. In principle all could pass near or directly under such property with imperceptable affect, provided suitable precautions are taken. However, it is recognized that the design and execution of tunnel work is not infallible and that unforseeable adverse affects are possible. Since none of the alternatives involve intentional or predictable effect on National Register properties the evaluations are based rather on the relative potential for adverse impact. Accordingly the number of affected historic properties, their relative importance, and the extent of required precautionary measures and controls were among the several critical issues which led to discarding all alternatives except the D-2 alignment.

EXHIBIT A indicates the various National Register properties within each alignment's range of influence and comments upon potential impacts. Descriptive data and important issues relative to each alternative alignment is shown in tabular form by EXHIBIT M.

SELECTED ALIGNMENT/CONSTRUCTION ALTERNATIVES

The proposed 250 ft. curve radii at Harvard Square is a substandard transit design. The minimum curve radii normally should not be less than 500 ft. The transit alignment within the National Historic Districts contains curves less than desirable minimum to insure no adverse impact to the adjacent structures within the district and maintain construction activity on public right-of-way.

The selected alignment will be constructed by the cut-and-cover method utilizing the slurry wall technique. This technique, although generally more expensive than conventional methods, will provide the required protection to the adjacent structures and minimize surface disruption. Other techniques were considered but dismissed, including:

Deep Bore Tunnel - Since the proposed tunnel connects to the existing facility, it was not possible to obtain the amount of cover normally required over a bored tunnel. The top of the existing structure is about 2 ft. below ground.

Soldier Pile and Lagging - This cut-and-cover technique, although most economical, does not provide the desired protection of adjacent structures. Other methods, such as underpinning, would probably have to be used to protect the adjacent structures.

Sheet Piling - Another cut-and-cover technique that would not provide the building protection that slurry wall provides. Other methods would have to be used to protect the structures.

Continuous Bored Piles - This technique is comparable to the slurry wall. However, there are a limited number of contractors in this country who have expertise with this technique.

All prudent and feasible alternatives have been explored and all design proposals have been reviewed and approved by local and state historical preservation officers (see Exhibit O). All planning to minimize harm to the historical districts during and after construction has been performed.

North Cambridge Avenue Congregational Church

Description and Use

The North Avenue Congregational Church on the east side of Massachusetts Avenue at Roseland Street is of primary importance and is expected to be a National Register nominee. Built in 1845 and designed by Architect Isaac Melvin, this handsome Egyptian-Greek Revival church is an essential visual focus and important landmark in North Cambridge.

Probable Impacts

Construction by the tunnel/deep bore method well below the existing land surface is proposed for this section of the project. As a result, no taking or destruction of this historic resource is anticipated. Construction will occur beneath Massachusetts Avenue and would come no closer than 80 feet to the church. The activities at this church may be disrupted for a short time due to station construction, but no structural or long-term impacts are expected. Vent and relief shafts would be located several hundred feet from this structure.

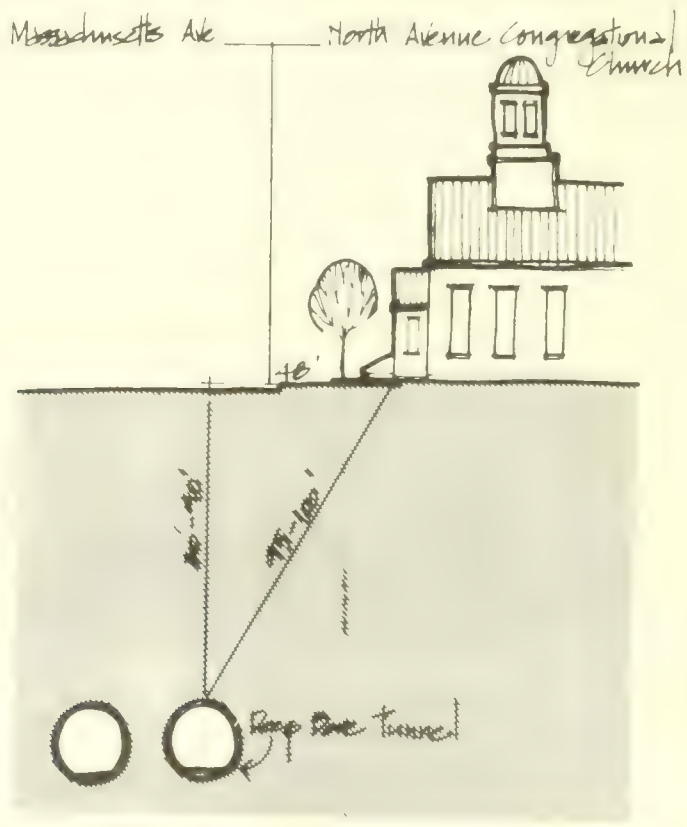
This building should not experience settling and other structural impacts during construction of the tunnel under Massachusetts Avenue. The nearest surface construction is about 500 feet north of the building.

Alternatives

The alignment for this section of the project, as it passes by the church, is at about the centerline of Massachusetts Avenue in a deep bore tunnel. There is no need to move the alignment west of the centerline of Massachusetts Avenue since there are no potential impacts to the church. However, some impact could occur to the four and six story structures on the other side of Massachusetts Avenue.

Mitigating Measures to Minimize Harm

This church, as well as all historic structures which potentially could be affected, will be closely monitored during the construction process and will be examined periodically following completion. In the event that damage appears, appropriate repairs will be made in keeping with the authentic character of the structure. Ongoing coordination with the Cambridge Historical Commission will be maintained throughout the construction process to assure an absolute minimum of disruption.



Tunnel Section
at
North Avenue
Congregational Church

1847-53 Massachusetts Avenue

Description

This fine brick business block, completed in 1882, still has its original detailing. It defines the commercial district of Porter Square as an urban streetscape and has been classified important.

Probable Impacts

Construction by the tunnel/deep bore method well below the existing land surface is proposed for the section passing this structure. As a result, no taking or destruction of this historic resource is required. The activities in this building may be disrupted for a short time due to construction of the Porter Square Station, but no structural or long-term impacts are expected. Vent and relief shafts would be located several hundred feet from any historic building along this section.

Alternatives

All other alternatives to the proposed project for this section (tunnel/deep-bore beneath Massachusetts Avenue) besides a deeper tunnel would have substantially greater impacts on this structure or other structures in the vicinity.

Mitigating Measures to Minimize Harm

This historic structure will be closely monitored during the construction process and will be examined periodically following completion. In the event that damage appears, appropriate repairs would be made in keeping with the authentic character of the structure. Ongoing coordination with the Cambridge Historical Commission would be maintained throughout the construction process.

Russell Field

Description

Russell Field is a 9.8-acre recreational park in northwest Cambridge, bounded by the Fitchburg Main Line tracks, Clifton Street, Rindge Avenue, and the W. R. Grace, Inc. complex.

Russell Field offers football, baseball, basketball and unorganized recreational activities for all age groups. The facilities include a football field with bleachers, scoreboard, and goal posts; a quarter-mile cinder track; a baseball diamond; totlot; a small parking area; and a locker room building with showers and dressing rooms.

Access to the field from the north and west is restricted by the railroad tracks and the industrial complex. Access to the east and south is via Harvey, Dudley, Rindge and Clifton Streets. Although a small parking lot is available, pedestrian access is very important.

Russell Field was acquired by the City of Cambridge in the early 1900's and has been used for recreation since that time. The field is under the jurisdiction of the Cambridge Recreation Commission which, in a 1972 letter to the BTPR, declared the public park to be of local significance. This declaration of local significance was reaffirmed in a letter to the MBTA from the City of Cambridge, dated August 16, 1976.

Probable Impacts

Most of the impacts on Russell Field would be relatively minor with respect to the recreational use of the parkland. Short-term disruptions from the construction process would be the most serious adverse effects.

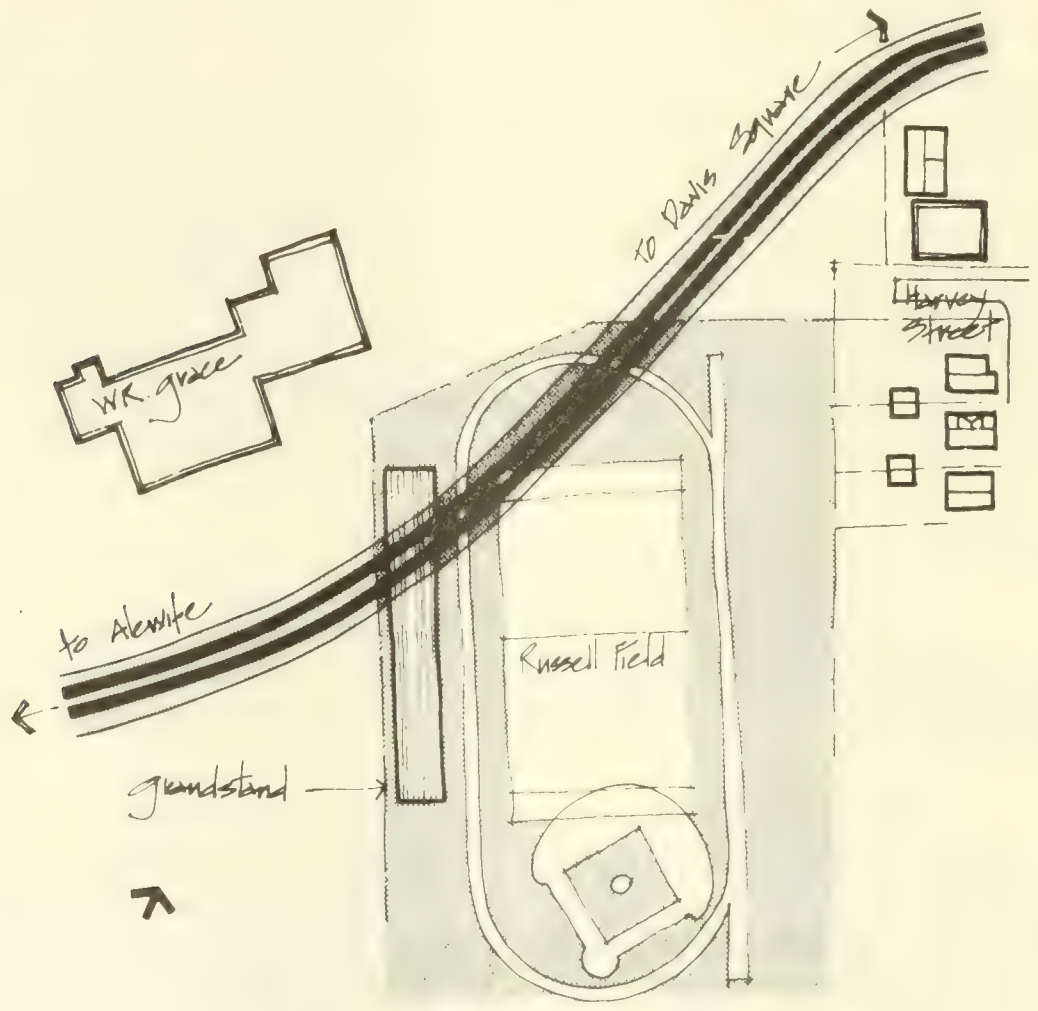
Although no permanent land taking would be required, construction of the project would require the temporary use of about 0.6 acres of land in the extreme northwest corner of Russell Field. A permanent easement would be required. This acreage would be subject to direct physical disruption from site clearance, excavation, new construction, and equipment and material storage for approximately six to nine months during the construction of the tunnel/cut-and-cover.

Those facilities which would be affected includes a small portion of the quarter-mile cinder track, the scoreboard and the north section of bleachers at the football field. Additional short-term indirect disruptions to adjacent recreational uses include potential nuisance from noise, vibrations and dust generated by construction equipment and operations.

Long-term positive and negative effects would also result from the project. A fan ventilation shaft, located approximately 100 feet west of the northwest property line, may cause a slight increase in ambient noise levels and movement of transit vehicles in the tunnel would cause some ground vibrations. These minor impacts, however, should not greatly affect

the recreational use of Russell Field. Development of the linear park system, which would connect Russell Field with other open space and recreational facilities in the area, would be a beneficial long-term impact.

Alignment through Russell Field



Alternatives

The basic premises guiding the engineering design of the project alignment through Alewife was to maximize as much as possible the existing South Acton Freight Cutoff and Lexington Branch rights-of-way for the project right-of-way. To do this, it is necessary to cross the northwest corner of Russell Field. Any other alignment north or south of the proposed alignment through Russell Field would throw the alignment off the Freight Cutoff and Lexington Branch rights-of-way, which in turn would either require the taking of residential structures in North Cambridge or the encroachment on additional lands of the Alewife Brook Reservation. Both of these would result in impacts more severe than those that would occur to Russell Field under the proposed project. In both cases, impacts would be long term and irreversible.

Construction Alternatives

The tunnel/cut-and-cover construction through Russell Field requires the use of a groundwall support system. The purpose of the groundwall is to keep the excavation within the width required for tunnel construction rather than an open cut with side slopes. The specific groundwall technique will depend on soils conditions, ease of excavation, etc. Presently, slurry wall and sheet piling are under consideration.

Mitigating Measures to Minimize Harm

Construction would be coordinated with the seasonal use of the football field so that the short-term disruptions would not coincide with the maximum usage of the affected facilities. After completion of the tunnel/cut-and-cover construction, the affected area (cinder track, scoreboard, bleachers and field) would be restored to its present condition by regrading, sodding and repairs. The fan ventilation shaft would be treated for noise reduction through the use of unobtrusive physical screens or vegetation. Pedestrian and bike access would be provided through linkage to the linear park system. All mitigating measures would be coordinated with the Cambridge Recreation Commission. The commission has indicated a willingness to cooperate with the MBTA. It has expressed an interest in obtaining excavated material from the Red Line construction to raise the existing level of Russell Field to provide better drainage to the field. This potential will be further explored during the preliminary engineering phase of the project. Should this proposal be implemented, the Recreation Commission has indicated a willingness to allow the field to be used as a contractor staging area. After the fill is in place, the whole field would be graded, loamed and seeded. The design of the linear park would be the responsibility of the local communities.

Alewife Brook Reservation

Description and Use

The Alewife Brook Reservation can be described in terms of two contiguous areas, for purposes of review and in light of the description of the Reservation land contained in the MDC's April 28, 1977, letter (see page II-180). These areas are:

> Alewife Brook Reservation East. This area includes the Alewife Brook Parkway corridor, which extends from Concord Avenue in Cambridge to the Mystic Valley Parkway in Somerville. It also includes the Yates Pond area, bound by the Parkway, Route 2, and the MBTA Commuter Rail Lexington Branch and Freight Cutoff; lastly, it includes the area just west of the Bedford Branch, north of the Freight Cutoff, south of

Route 2, and generally east of a north-south line which includes the westerly boundary of the ADL parking area. This parking area is leased to ADL by the MDC. As noted in the MDC's letter of April 28, 1977, this portion of the Reservation is characterized by the transportation uses which predominate in this area.

Limit of
Alewife Brook
Reservation East

Alewife Brook Reservation West. This area includes the Little Pond, Little River and the associated open-space areas west of the Alewife Brook Reservation East, as described above. This area is generally bound by the Arthur D. Little property on the north, the Freight Cutoff on the south and Belmont residential

[illegible] on the southwest and west. It also includes the Belmont Skating Rink, situated within the Route 2/Lake Street interchange.

The total area of the Alewife Brook Reservation (East and West combined) amounts to approximately 124 acres.

Although the Metropolitan District Commission has determined that the portion of the Alewife Brook Reservation through which the transit project will pass is not significant, the Urban Mass Transportation Administration has not taken a position on this issue. However, a full 4(f) analysis meeting all provisions of the 1966 DOT Act has been conducted for the impacts of the project upon the Alewife Brook Reservation and is included as part of this 4(f) statement.

Concurrent Highway Project

It is noted at this point that there are two separate transportation projects being proposed for the Alewife area. One is the MBTA's Red Line transit project, which is the subject of this document, and the other consists of roadway improvements being planned by the Massachusetts Department of Public Works (MDPW). The basic objectives of the proposed highway project are described in the MDPW Environmental Overview Summary Update (EOSU) as follows:

(1) Improvement of vehicular and pedestrian safety on the Alewife Brook Parkway and the Concord Turnpike (Route 2);

(2) Improvement of required vehicular and pedestrian access to adjacent development, particularly the so-called "Industrial Triangle" area south of Route 2 and west of Alewife Parkway;

(3) Provision of improved vehicular and pedestrian access to the proposed Massachusetts Bay Transportation Authority Red Line station/garage at Alewife.

The EOSU points out that the third objective depends on the independent action of UMTA and the MBTA; namely, the extension of the Red Line to Alewife and that, regardless whether the transit project is approved and implemented, the MDPW project should be implemented to achieve the first two objectives. Similarly, as is discussed on page VI-21, the MBTA is prepared to proceed with garage and station construction at Alewife with provisions for access from existing local streets. While the transit and highway projects are separate and independently viable, however, the planning of the two have been closely coordinated. A more detailed summary of the MDPW's proposed improvements is found on pages VI-21 to VI-25 and the full EOSU, which includes a discussion of the 4(f) and other impacts of the highway project, is attached to this EIS at Appendix J.

The Federal Highway Administration has not completed their review of the Environmental Overview Statement update (EOS). In the absence of this review, the Urban Mass Transportation Administration has decided to proceed with a single 4(f) statement covering only the transit project at Alewife.

Historical Context

The catalyst for the acquisition of the entire Alewife Brook Reservation was a malaria epidemic in the surrounding communities caused by unsanitary conditions in the Alewife marshes. In order to eliminate the malarial breeding grounds, a State Board of Health Report to the Legislature in 1906 recommende the acquisition of these lands. Subsequently, utilizing the so-called Boulevards Act, the Metropolitan Parks Commission (the MDC's Predecessor) acquired the lands from the mouth of the Alewife Brook at the Mystic River to the Little and Spy Ponds in Belmont and Arlington. This was a linear distance of approximately 2.5 miles. The width of the landtakings varied between approximately 200 and 1000 feet (average width approximately 400 feet) and was governed by the plan of sanitation for the malaria problem. In addition, the land, having been acquired under the Boulevard Act, was to be the site of a "parkway" which would serve to provide a road connection between the Mystic River area to the north and the Fresh Pond-Charles River area to the south. Due to the subsequent redesigns of the roadway, it was built further east on its present alignment. This alignment left undeveloped a parcel of land to the west which remains as open space today.

While the Commission continues to exercise jurisdiction over the Alewife lands, there exists legislation which reserves for the MBTA transit program the bulk of the land in the area which may be affected by the proposed transportation projects. Specifically, Chapter 491 of the Acts of 1951, as amended by Chapter 441 of 1960 and Chapter 618 of 1970, reserves 52 acres of MDC land in the Alewife area for transportation use, subject to further legislative action upon finalization of plans for transportation projects. This reserved area lies west of the Boston and Maine Railroad's Lexington Branch (also known as the Bedford Branch) and runs up to, but does not include, Little Pond.

Alewife Brook Reservation East

The Alewife Brook Parkway corridor itself within the Alewife project area is used for a variety of trip purposes, chief of which are for commuting and shopping and business access to adjacent commercial and industrial development. It is not restricted, like other MDC Parkways, to pleasure vehicles only. Between Concord Avenue and Dewey-Almy Circle, little to no abutting open space exists within the Parkway corridor. Northward from Dewey-Almy Circle, a linear open-space corridor exists, concentrated primarily on the westerly side of the Parkway, and it includes the Alewife Brook.

The remaining portion of the Alewife Brook Reservation East, generally located south of Route 2, between the ADL complex and the

Parkway, possesses both developed and open-space uses. The developed uses include the parking area leased by ADL from the MDC and the Boston and Maine Railroad trackage which crisscrosses or bounds the area. The open-space areas between these developed uses have been disturbed in varying degrees by man. Being mostly lowland, reed grass, cattail, sumac, blackberry and red maple are the major forms of vegetation found in this area. Wildlife found there includes the redwing blackbird, starling, swamp sparrow, pheasant, duck, gray squirrel, rabbit, field sparrow and goldfinch.

Unorganized activities such as walking and bicycling have been observed along the Parkway/Alewife Brook corridor north of Dewey-Almy Circle. Some occasional unorganized activities such as walking have also been observed in the Reservation East along the Little River in the vicinity of the ADL parking area.

Alewife Brook Reservation West

This portion of the Reservation is composed primarily of open-space lands, with the skating rink at the westernmost end being the only improved facility located within its limits. Unorganized activities have been observed in this area, including walking, birdwatching and other activities passive in nature. There are no organized acitivities undertaken by the MDC in this area, nor are there any recreational facilities located here, with the single exception of the skating rink. This rink, which is located within the southeast portion of the Route 2/Lake Street interchange, has been inoperable since 1970, and the paved parking area surrounding the rink is used as a "park-and-ride" facility for MBTA buses running to and from Cambridge.

Access to the Reservation West's open-space lands is limited, as there are no official roads entering the Reservation. Access is gained generally by foot, through private property, including the Arthur D. Little, Inc. property, along the Boston and Maine Railroad's right-of-way, or by local paths, mostly on private property, in Cambridge or Belmont.

Probable Impacts

Although the alignment selected for this section of the project would have less impact on the wetlands than the other possible alignments, implementation of the transit project would cause temporary disruption of the wetland biotic communities and result in short-term degradation of water quality.

Since most of the tunnel/cut-and/cover construction would be confined to the existing Lexington Branch railroad right-of-way, severe disruption to the adjacent wetland vegetation would be avoided. However, construction of the tunnel requires crossing two streams: Alewife Brook, which at the point

of crossing, is a small tributary flowing northward from the West End Iron Works; and the Little River, which comprises the major flow at the point of crossing. To maintain the flow during construction, the Little River would have to be diverted from the existing stream channel around the tunnel excavation and then returned to the original streambed after tunnel completion. The smaller flow from Alewife Brook would either be pumped across the excavation or temporarily channeled around the construction area. A major sewer presently in the area will be relocated across the Little River and Alewife Brook. The project includes the abandonment of the Lexington Branch. This construction would require space outside of the existing railroad right-of-way and would damage the existing wetland communities. Depending on the difficulties encountered during construction, the temporary use of one to three acres of land beyond the right-of-way may be required. All land required for construction activities would be part of the East Reservation Area. Such use would eliminate, for all practical purposes, the existing vegetation and wildlife habitat. The proximity of Route 2 and the encroachments of the A. D. Little parking lot and the railroad embankments have disrupted the existing wet meadow and only marginal habitat is provided. Songbirds and small mammals which utilize the food resources and vegetative cover would be displaced by the project.

The construction techniques utilized in crossing Alewife Brook in the East Reservation Area and the Little River would alter the existing aquatic habitat. Since these portions of the streams are already polluted, the potential severity of this impact would be reduced. Only pollution tolerant organisms are found here at present. Removal of polluted sediments and reconstituion of the streambed after tunnel completion may improve a portion of the aquatic habitat. Although only a small area of streambed would be dredged, the quality of the bottom sediments to be removed would be analyzed before excavation to determine acceptable methods for handling and disposal of sediments to prevent entry of contaminants into ground or surface waters. Since stream flow would be diverted prior to removal of sediments, no contaminants woud be dispersed downstream. The details of construction, sequencing, sediment disposal, and erosion control procedures would be determined during final design of the project.

Another short-term negative impact of the project would be siltation below the construction zone. Sediments would potentially enter Alewife Brook from excavation dewatering, other construction processes, and erosion of exposed soils in the construction area. Suspended silt would periodically be carried downstream as far as the Mystic River, causing high turbidity and potentially lower dissolved oxygen concentrations, some sediments would be deposited along the river, particularly where the current is stilled and pools are found. Biologically, the siltation would suffocate many benthic organisms, thus impacting community structures, and inhibit photosynthesis in affected areas. Most fish would avoid those reaches of the stream affected

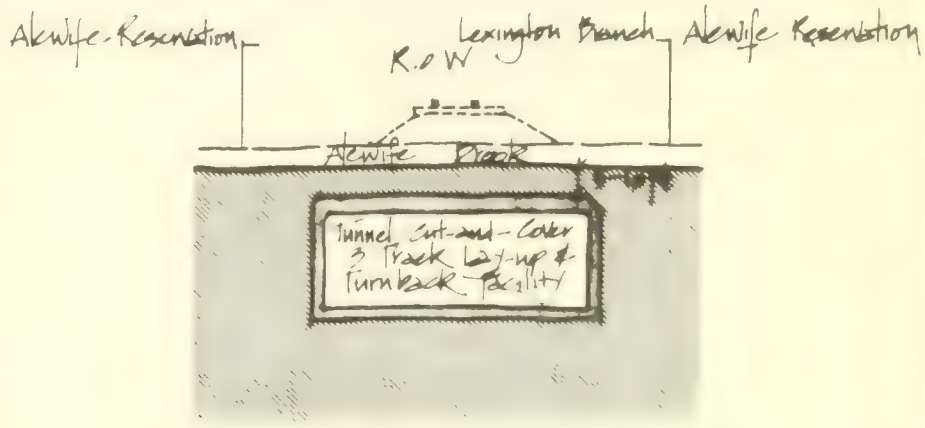
by high turbidity and sport fishing would be generally unproductive. Serious sedimentation would not be continuous throughout the one-to three year construction period, but would occur during heavy rains or snow melts. After project completion, water quality would return to preconstruction conditions and an aquatic community similar to the one presently found would be re-established.

These impacts which could potentially result from construction activities in the East Reservation Area can be virtually eliminated by controlled construction activities and mitigating measures. The Authority is committed to a program of controlled construction activities for the purpose of reducing impacts to the East Reservation. The following section on mitigating measures discusses this program in detail.

No adverse impacts on floodwater storage capacity or groundwater are anticipated. The tunnel/cut-and-cover is totally below the groundwater. Within the Reservation, the top of the tunnel is five feet below groundwater within a fine to medium sand strata. Any ground water flows will continue over the tunnel. Consequently, it should not have any effect on groundwater movements. Flood storage capacity of the Alewife area may be nominally increased by the removal of the existing railroad embankments and the possible removal of an artificial berm west of the embankment.

A secondary impact would be the increased recreational and educational potential of the Alewife wetlands due to their improved accessibility resulting from the transit station and the potential connection to the proposed linear park scheme. To preserve the natural character of the most valuable and ecologically sensitive wetland area (located near the geographical center of the wetlands), and to avoid damage from overuse, limited pedestrian access is recommended. Development of a nature trail to educate the people about the value of the wetlands and the maintenance of buffer areas with unimproved trails may be useful in this endeavor.

Long-term impacts resulting from alignment across the Reservation may include increased ambient noise levels and ground vibrations.



Tunnel Section beneath Alewife Brook

Status of Alewife Reservation Under Section 4(f)

The lands treated elsewhere in this Section 4(f) Statement have been found by the agencies of jurisdiction to be significant Section 4(f) properties. On the other hand, there has been some question as to the status of the Alewife Reservation. Up until recently, the agency of jurisdiction over this land, the Metropolitan District Commission, has not reported to the MBTA its position regarding the land's significance under Section 4(f). In the absence of such a statement, the studies prior to this time, including the Draft EIS for the Red Line project, properly assumed that the MDC Alewife land was significant 4(f) land.

Recently, however, the MDC has forwarded its findings in this matter to the MBTA. In its letter of April 28, 1977, found at page II-180, the MDC has found that the "East" portion of the Reservation is not significant under Section 4(f).

The U. S. Department of Transportation, Urban Mass Transportation Administration, has reviewed this matter and has made the following judgments.

Some have questioned whether this land is in fact a "public park" or "recreation area" within the meaning of Section 4(f). There also appears to be some merit to MDC's finding of insignificance in respect to the land to be impacted, given the surrounding transportation elements and the reservation of land for MBTA use. On the other hand, a local group has written the Department asking whether the MDC determination is appropriate in that it applies to but a portion of the Reservation. Recognizing that sound argument can be made for either position, given the sensitive nature of the issue and the fact that the Reservation is classified as "Parkland", we have determined it to be in the best interest of the Department to proceed with a Section 4(f) Statement without necessarily finding that the land to be impacted is significant for purposes of Section 4(f).

Alternatives

Other sections of this EIS document discuss the narrowing of alternatives that resulted in the present proposed project. Chapter IX discusses the various alternatives to extending the Red Line from Harvard Square to Arlington via Alewife. Included in that chapter are the findings that none of the alternatives, including the No Build, are prudent and feasible. Chapter VI similarly describes the decisionmaking with respect to station locations in the Alewife area. Given this situation--the need to construct the Red Line to Arlington and the need for a station at Alewife--it is impossible to reach Arlington without, in some way, impacting the Alewife Brook Reservation. In particular, there is no prudent and feasible alternative to crossing the MDC Reservation. Moving the alignment in either direction off the proposed location within the Boston and Maine's Lexington Branch right-of-way would only increase impacts to the Reservation.

Construction Alternatives

The tunnel/cut-and-cover construction through the Alewife Brook Reservation requires the use of groundwall support to maintain the excavation within the railroad right-of-way. Due to the geologic conditions through this area, it is anticipated that either the slurry wall technique or sheet piling will be utilized.

Mitigating Measures to Minimize Harm

A number of conservative construction techniques would be employed to mitigate short-term impacts of the transit project. During the actual construction process, sediment basins and traps, temporary culverts and dust control, grade stabilization structures and other erosion control methods would be used to prevent excessive erosion and siltation. Existing vegetation would be preserved to the extent possible and vegetation that would be removed would not be stripped away until necessary. After project completion, slopes would be graded and promptly revegetated, either with sod or a seed mixture held in place by mulch or jute. Specific designs for sediment basins and traps culverting and other erosion control techniques would be detailed during the final engineering phases.

Construction of a retention or detention pond on the station site and removal of unnecessary embankments would improve the flood storage capacity of the Alewife area.

Efforts to improve the wildlife diversity and productivity could be assisted through coordination with the State Department of Natural Resources, the U. S. Fish and Wildlife Service or active environmental conservation groups. Although such a wildlife improvement program would be implemented in areas of the Reservation relatively removed from the transit right-of-way, impetus for implementation is clearly the Red Line Extension. As a consequence, the MBTA would work closely with the MDC and other pertinent agencies in coordinating enhancement efforts, obtaining appropriate expertise and advice, and developing detailed plans to be implemented during or after construction of the transit project.

Necessary Federal and State water quality and wetlands permits, such as the Corps of Engineers permit for activities in navigable waters, would be obtained during final design to ensure project conformance with applicable environmental standards.

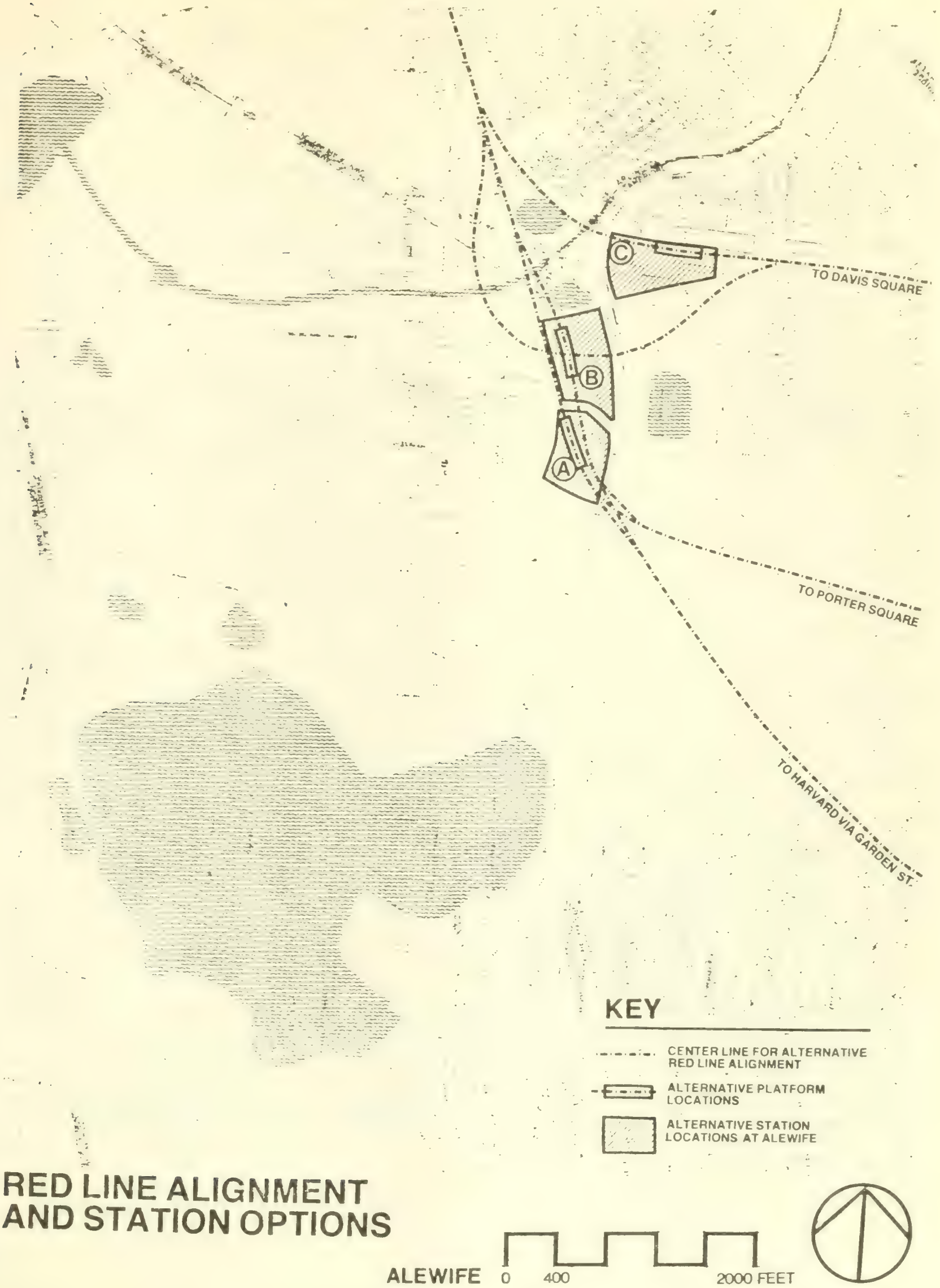
Thorndike Playground

Description and Use

Thorndike Playground is a 7.8 acre recreational field located in East Arlington. It is bounded by Margaret and Edith Streets to the north, the former Boston and Maine Lexington Branch to the east, and Route 2 to the south. To the west there is an undeveloped land parcel, known as the Mugar property, for which a major mixed use development is planned.

With exception of a paved basketball court, the playground is grass covered and is used for field sports such as football, soccer, volleyball and other activities requiring open areas. Two baseball diamonds with backstops are used for Little League baseball and softball. Two swing sets and other play facilities are available for younger children. Since it is the only large open field in East Arlington, it serves the recreational needs of a large population and is intensively used, particularly during the summer. Many supervised programs use the facilities including the Summer Playground Program, the Men's Softball League and the Suburban Girl's Softball League (five nights a week, May through August) and during the fall months, it is used for high school football and soccer. While people of all ages use the playground, young people are the predominant users, especially during the summer when average daily attendance approaches 200 people.

For additional information on Alternative Alignments and Alternative Station Locations in the Alewife Brook Reservation Area, which have been studied in the E.I.S., please refer to Chapters VI and IX.



RED LINE ALIGNMENT AND STATION OPTIONS

Access to Thorndike Playground is fair via Margaret Street to the north or Thorndike Street to the east. Thorndike Street, however, crosses the Boston and Maine Lexington Branch railroad at grade. An unpaved access road and parking area parallels the eastern border of the playground and connects Margaret and Thorndike Streets. Although the Lexington Branch acts as a barrier to vehicular access, the right-of-way does provide a linear link for East Arlington residents who walk to the playground.

In view of its intensive use and only fair access, in the 1972 Arlington Open Space Study it was recommended that accessibility be upgraded by marking its location with signs on nearby streets and improving the parking capacity.

Thorndike Playground is the only sizable open space in southeastern Arlington and serves a large recreational district. The Magnolia Street and Hardy School Playgrounds are nearby, but their small size and limited facilities provide recreational activities mainly for younger children.

The Town of Arlington has developed a plan to provide a Linear Park link between the various open space and recreational facilities. An important step toward achieving this goal was taken when a Town warrant was passed which authorized the purchase of vacant private land between the Thorndike Playground and the Magnolia Street Playground. This purchase would include the abandoned Boston and Maine railroad right-of-way which spurs off the Lexington Branch and the cattail marsh near Dewey and Almy Circle.

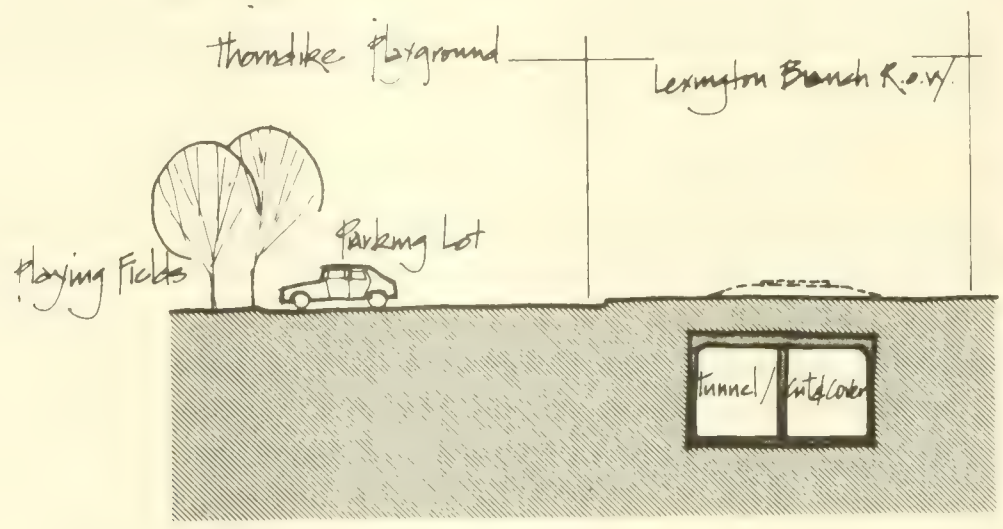
Starting at Arlington Center, this linear link would follow the path of the Lexington Branch right-of-way and would include Spy Pond and Thorndike Playground. After connecting with the Metropolitan District Commission's land holdings, it would follow Alewife Brook downstream to the Mystic River and upstream to Mill Brook.

Throndike Playground, wedged between heavily trafficked Route 2 and a railroad, is not a desirable location for a recreational facility. A dense row of trees provides a visual barrier to Route 2, but this playground has a low-lying position and is hydrologically connected to Alewife Brook. Consequently, it often functions as part of the Alewife Brook floodplain during heavy storms.

The Thorndike Playground is owned by the Town of Arlington and is under the jurisdiction of the Arlington Parks Commission. During the BTPR Study, a letter, dated November 7, 1972, was received from the Chairman of the Board of Park Commissioners. This letter declared the Thorndike Playground to be of local significance. A letter reaffirming this designation was sent by the Board of Park Commissioners to the MBTA on February 6, 1976.

Probable Impacts

Because the alignment for this section of the project will fall totally within the Lexington Branch right-of-way, no taking of any portion of Thorndike Park will be required. Nor will any long-term impacts occur to activities carried on at this facility because of the project being in a tunnel section. The only real impact to this facility will occur during the construction period at which time machinery noise and dust may have a disrupting effect on facility use.



Tunnel Section adjacent to Thorndike Field

Alternatives

Moving outside of the Lexington Branch right-of-way to reduce short-term construction impacts to Thorndike Playground would require placing the alignment and its tunnel section closer to the residential areas of East Arlington on the east side of Lexington Branch. This would increase noise and vibration impacts to the East Arlington neighborhood and may possibly require taking some residential or garage structures and displacing conservation land.

Mitigating Measures to Minimize Harm

Construction would be coordinated with the seasonal uses of the baseball diamonds so that short-term disruptions would not coincide with the maximum usage of the facility. After completion of the tunnel/cut-and-cover construction, the affected area would be graded, sodded and landscaped. This would enable development of the linear park along this section to tie Thorndike Playground, Magnolia Street Playground and the Alewife MDC reservation into the Town's overall open space system.

Protective measures such as tagging and fencing will be used during construction to ensure that the several large trees existing along the Lexington Branch right-of-way next to Thorndike Playground will be preserved.

The abandonment of the Lexington Branch Railroad as a result of this project will provide the linear park link desired by the Town of Arlington.

Provisions will be made for protected walkways across the construction areas to ensure continued safe access between the facility and East Arlington during the construction period.

Spy Pond Park and Totlot

Description and Use

The principal activities at this 1.8 acre facility are children's unsupervised play and family picnicking. The landscaped park has five picnic tables, four outdoor grills, numerous benches, and a variety of playground equipment such as merry-go-round, slides, and swings. In 1977, construction of a boat ramp, boat dock, parking for cars and trailers, realignment of Pond Lane, traffic control devices at the railroad underpass and new picnic tables and landscaping is to be funded by the Public Access Board.

While the Pond Lane Park receives intensive neighborhood patronage from the East Arlington residents, it is also important to the entire Town of Arlington because of its frontage on Spy Pond. Here families can enjoy the pleasing visual aspects of Spy Pond while picnicking or relaxing. Activities of the Summer Playground Program for East Arlington are centered on this park and usage is, therefore, heaviest during the summer.

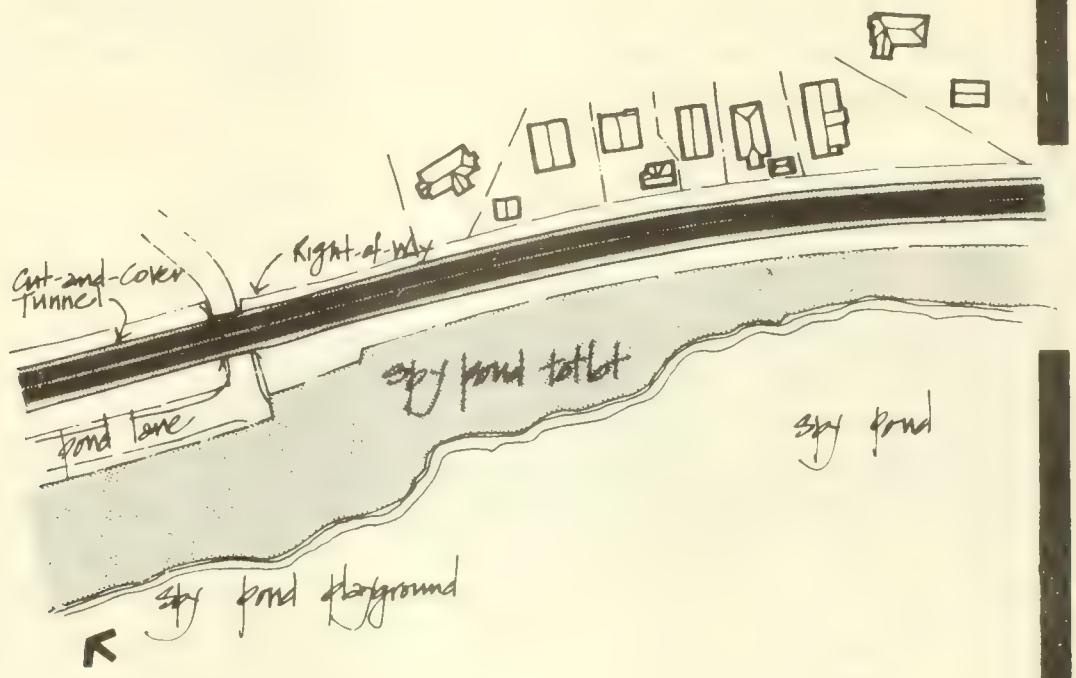
Present access to the Pond Lane Park and Totlot is poor. Although a small paved parking area is available to the west by Pond Lane, the vehicular approach is dangerous and most access is by foot. Primary access is provided by a path which extends from Pond Lane under the Lexington Branch right-of-way. Pedestrian access is also possible from both Spy Pond Field and Scannel Field.

No other park in the East Arlington area has comparable facilities to the Pond Lane Park and Totlot. As one of the Spy Pond Shore parks, it provides limited access to the Spy Pond, which increases its importance.

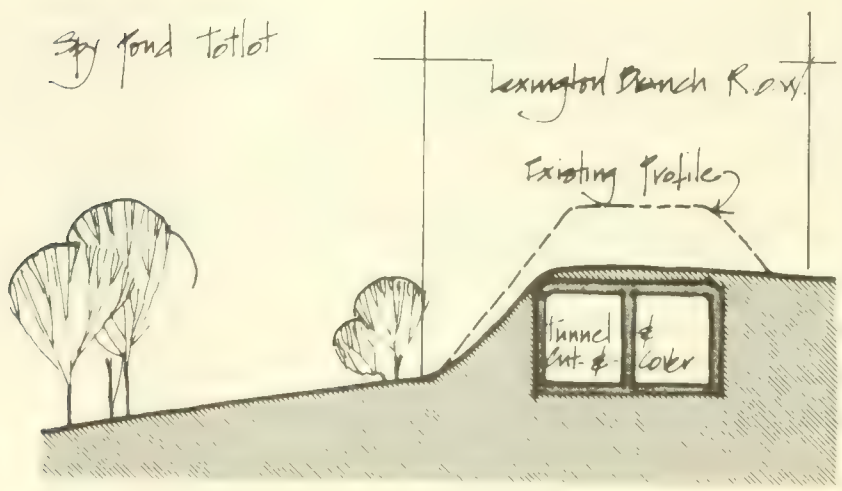
The Pond Lane Park and Totlot would be one of the parks in the greenbelt system to link recreational facilities. This proposed plan is detailed in the Arlington Open Space Study.

Probable Impacts

The Totlot abuts the railroad right-of-way. Construction would occur without taking land. Regrading of the surface above the tunnel structure will lessen the existing visual impact of the embankment and provide a broader area for the linear park concept. These requirements will be a function of final design and would be carefully coordinated between the Town of Arlington and the MBTA. The covered tunnel section would then be the basis of a linear park spine, furnishing greatly improved safety and access for users of the Totlot and Pond Lane Park.



Alignment along Spy Pond Tot Lot



Tunnel Section adjacent to Spy Pond Tot Lot

Alternatives

Because of the narrowness of the Lexington Branch Railroad right-of-way at this point, shifting the project alignment to the north to reduce short-term construction impacts to the Spy Pond facilities would greatly increase long-term noise and vibration impacts to several residential structures and may even require displacement of these structures.

Construction Alternatives

The tunnel/cut-and-cover construction adjacent to Spy Pond Park and Totlot requires the use of groundwall support to maintain the excavation within the railroad right-of-way. All the conventional cut-and-cover techniques could be utilized. Further soil studies will determine the most advantageous alternate.

Mitigating Measures to Minimize Harm

Boat launching and lake-oriented recreational activities will be able to continue throughout the construction process. The noise, dirt and dust generated by construction activities will impair the use of the Totlot for approximately 15 months during the surface construction phase of the project. Due to the close proximity of the construction activities and Totlot play apparatus, special precautions, such as sheeting will be required to close off the construction site from those using the adjacent park area. Such a barrier can serve multiple functions in order to reduce noise, visual intrusion and the spillover of construction debris into the Totlot area. If it is determined by the Town of Arlington that the Totlot equipment functions should be temporarily relocated during the construction process, these provisos will be incorporated into the construction documents and implemented under the supervision of the Town of Arlington and the MBTA.

As a result of this project vehicular access will be greatly improved.

Arlington Town Center Historic District

Description and Use

The Arlington Town Center Historic District is peripheral to the project corridor (it is bounded by Massachusetts Avenue and Academy, Maple and Pleasant Streets, excluding the southeastern corner of the block) and it contains a number of notable structures and sites important to Arlington's historical development. These include: Whittemore-Robbins House, Federal Style (c. 1795) Mansion in excellent condition now occupied by town offices; Robbins Library, Italian Renaissance Style built in 1892 with addition added 1930; Arlington Town Hall, built in 1912 and designed to complement the neighboring library; Robbins Memorial Town Garden, established between the Town Hall and the Library, featuring meandering sidewalks and pool designed

by Olmsted Associates; and the Old Burying Grounds, a Revolutionary War Cemetery. The First Parish Unitarian Church, a Victorian Style church built in 1856 on the corner of Massachusetts Avenue and Pleasant Street, was also an integral part of the District, but was, unfortunately, destroyed by fire in early 1975. As it is listed on the National Register of Historic Places, the District is classified as Primary Importance.

Impacts

There will be no short or long-term impacts to the Arlington Town Center Historical District.

Mitigating Measures to Minimize Harm

All above-grade elements of the Arlington Center Station will be designed in a manner to be compatible with the historic nature of the Town Center. Materials, building forms, signage and lighting will show sensitivity to the scale and character to the Historic District.

Whittemore Historic Park

Description and Use

Whittemore Historic Park is a small, 0.2-acre park located at the intersection of Mystic Street and Massachusetts Avenue in Arlington Center. It is bisected by the Lexington Branch railroad tracks. Established in 1976 as a Revolutionary War Memorial, it also functions as a rest area for shoppers.

The principal feature of the park is a memorial stone commemorating Samuel Whittemore, a Revolutionary War hero, and the Battle of Menotomy. Although most of the surrounding area is paved, it has been landscaped with shade trees, ornamental shrubs and grass. As park benches have also been provided, this small area furnishes a rest spot, removed from the street traffic, which is frequently used by shoppers, senior citizens, and young people. Access is by foot as it is located directly off the sidewalk along the north side of Massachusetts Avenue.

The park is owned by the Town of Arlington and is under the jurisdiction of the Board of Selectmen. In connection with the BTPR Study, letters of significance, dated February 2, 1973, were received from the Secretary of the Board of Selectmen relative to Whittemore Historic Park and the Uncle Sam Memorial Park.

Probable Impacts

This 0.2 acre park would have to be disturbed during cut-and-cover construction of the below-grade station at Arlington Center. It will be necessary to remove all trees and shrubs, benches and the Whittemore Memorial to facilitate excavation of the trench for construction of the Arlington Center Station. A permanent easement would be required.

Alternatives

Because the Lexington Branch right-of-way passes directly through the center of this park, the project alignment must also pass through the park. Moving it right or left of the Lexington Branch right-of-way would result in severe impacts to other properties in Arlington Center, including displacement of several businesses and residential structures. Thus, there is no prudent and feasible alternative to the temporary short-term use of this park.

Construction Alternatives

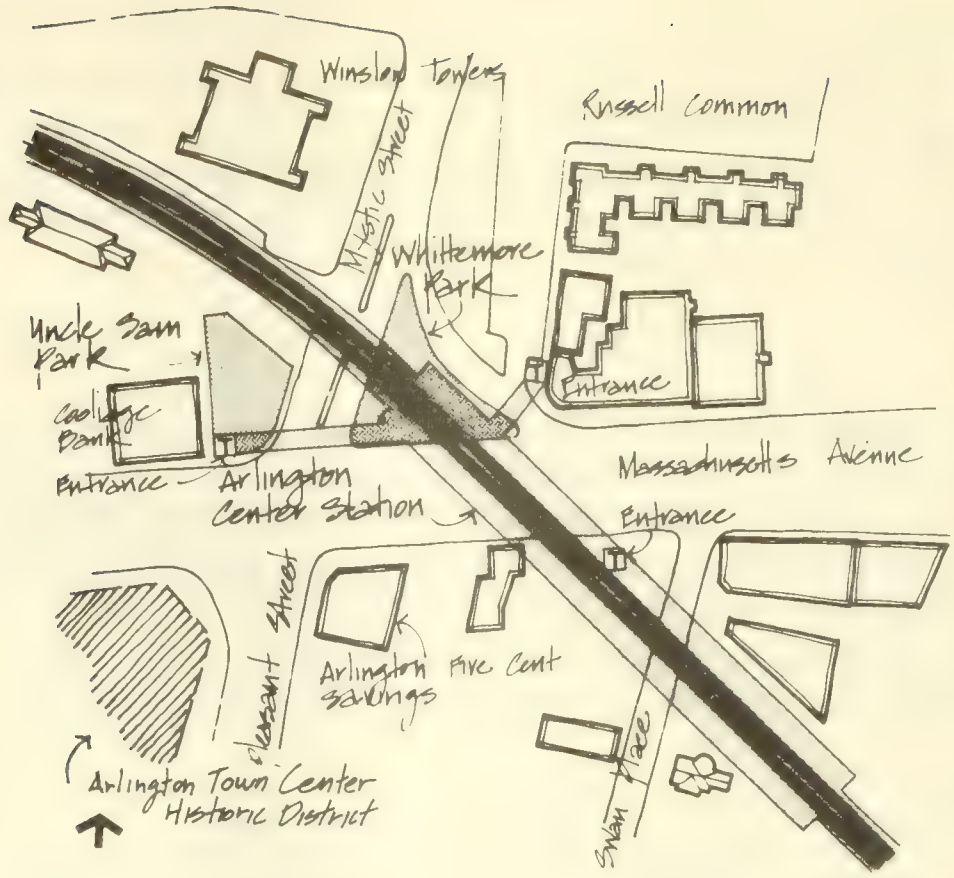
The tunnel/cut-and-cover construction through Whittemore Historic Park requires the use of groundwall support to maintain the excavation within the width required for tunnel construction. All conventional and special cut-and-cover techniques could be utilized. Further soil studies will determine most advantageous alternate.

Mitigating Measures to Minimize Harm

After completion of the Arlington Center Station, Whittemore Park will be restored with new grassing, landscaping, and trees. Possible inclusion of an at-grade mezzanine level for the Arlington Center Station as part of this park would provide a focal point for reconstruction of the Park. Elimination of the Lexington Branch right-of-way and its tracks and the right-hand-turning lane from Massachusetts Avenue to Mystic Street will increase the park's size by about twenty to thirty percent. The Whittemore Memorial will be reconstructed in the new park. Its new location will be planned through close coordination between the Town of Arlington and the MBTA. Alternative schematics for the reconstruction of this park will be developed during the preliminary design phase for the Arlington Center Station and reviewed with the Town of Arlington.

Traffic improvements proposed for the Mystic Street-Massachusetts Avenue intersection will eliminate the right-hand-turn lane from Massachusetts Avenue to Mystic Street, presently separating the park from Russell Common. This will increase the accessibility and attractiveness of the park, as well as making entrance to the station safer and easier for users coming from the northeast quadrant of the Center.

Alignment
through
Arlington Center



Uncle Sam Park

Description and Use

Uncle Sam Memorial Park is a 0.2 acre historic site located in Arlington Center on the northwest corner of the Mystic Street-Massachusetts Avenue intersection. It is the approximate site of the birthplace of Samuel Wilson, the progenitor of Uncle Sam.

A large statue has been erected on the site to commerate Samuel Wilson. In addition, the grass-covered site contains small landscaped areas and several park benches. The park is used by shoppers and senior citizens as a quiet rest area.

Probable Impacts

Construction of a proposed station entrance at the northwest corner of the Mystic Street-Massachusetts Avenue intersection will require partial use of this park. Approximately 400 square feet or about one-twelfth of the park area will be used for the station entrance. This will be a long-term reduction in the size of the park property. However, the actual area of the park will be increased because of the addition of a permanent easement at the north end of the park after construction is completed. In the short term, construction impacts of noise, vibration, and dust will probably make the park unusable during the period of construction.

Alternatives

The no-build alternative would preserve the park. It would, however, mean that persons coming from the northwest quadrant of the Center who want to board the Red Line would first have to cross heavily travelled Mystic Street to reach the Station entrance. This is not an ideal situation, particularly because this group of patrons would include the elderly residents of Winslow Towers.

Under the build case, locating the northwest quadrant station entrance anywhere other than in Uncle Sam Park would require either the displacement of structures or the reduction of sidewalk widths to a very narrow, almost unusable dimension.

Construction Alternatives

Construction of the entrance will utilize groundwall support techniques to avoid further encroachment into the park than that required by the width of the entrance. All conventional and special cut-and-cover techniques could be utilized. Further soil studies will determine most advantageous alternative.

Mitigating Measures to Minimize Harm

Prior to construction of the station entrance, the Uncle Sam Statue will be disassembled and either removed from the site and placed in safe storage, or temporarily or permanently relocated to another site. After completion of construction it will be returned to the park unless it is decided to place it elsewhere.

Reconstruction of the park will be planned through close coordination between the Town of Arlington and MBTA.

The design of the station entrance will be simple and subtle so as not to overshadow the scale of the Park and statue.

Granite Arch, Mill Brook

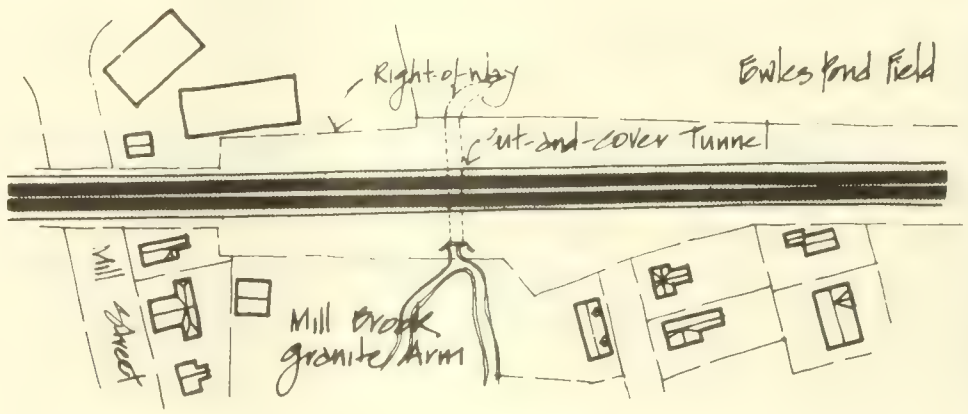
Description and Use

This archway, part of a railroad bridge constructed of cut-granite in 1845, adds a strong visual focus to a small open portion of Mill Brook. It is classified of primary importance by the Arlington Historic Commission.

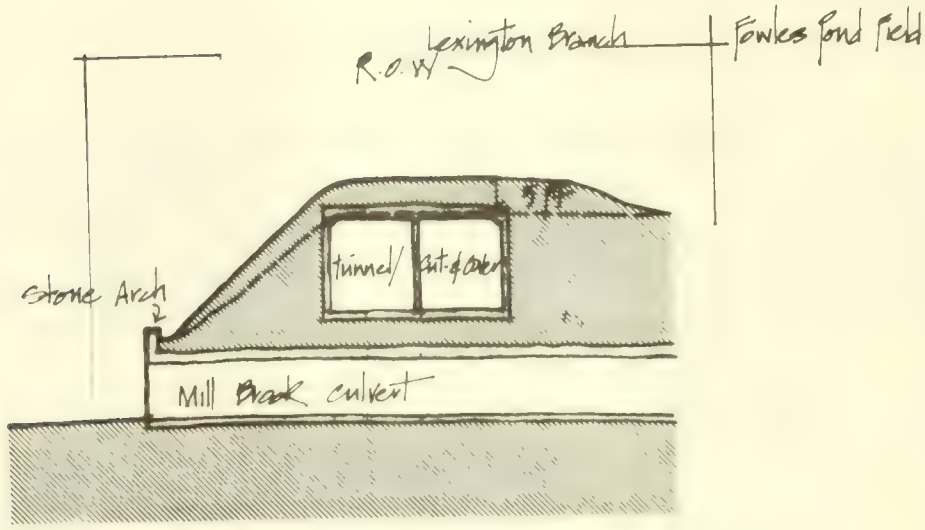
Impacts

This granite arch culvert will remain in place during excavation for and construction of the cut-and-cover tunnel which will pass over the Mill Brook culvert at this point.

Alignment across Mill Brook



Tunnel Section above Mill Brook



Alternatives

Construction of the tunnel across Mill Brook at any other point than where the Lexington Branch tracks cross the brook would increase project costs substantially. Moving the alignment south to bypass the culvert would require dropping the project profile approximately 30 to 50 feet because the tunnel could no longer be built within the existing railroad embankment. Moving the alignment north to bypass the culvert would impact Fowles Pond field. Either alternative alignment would require displacement of residential structures farther west along the alignment.

Construction Alternatives

Specific construction techniques will be developed during the design stage of this project. At present, it appears that there are a number of methods that could be used to preserve the archway during construction such as:

(1) Expose the culvert and design the tunnel to span across it.

(2) Expose the culvert. Remove the section of culvert under the tunnel. Rebuild culvert integrally with the tunnel.

Mitigating Measures to Minimize Harm

During construction, the granite arch will be reinforced and protected against damage. If it is found that it will be necessary to temporarily remove it to facilitate construction, the arch will be photographed, its stones numbered and indexed, and then disassembled and removed to a place of safe storage until the time it can be reassembled at the Mill Brook crossing.

Railroad Abutments, Brattle Street Crossing

Description and Use

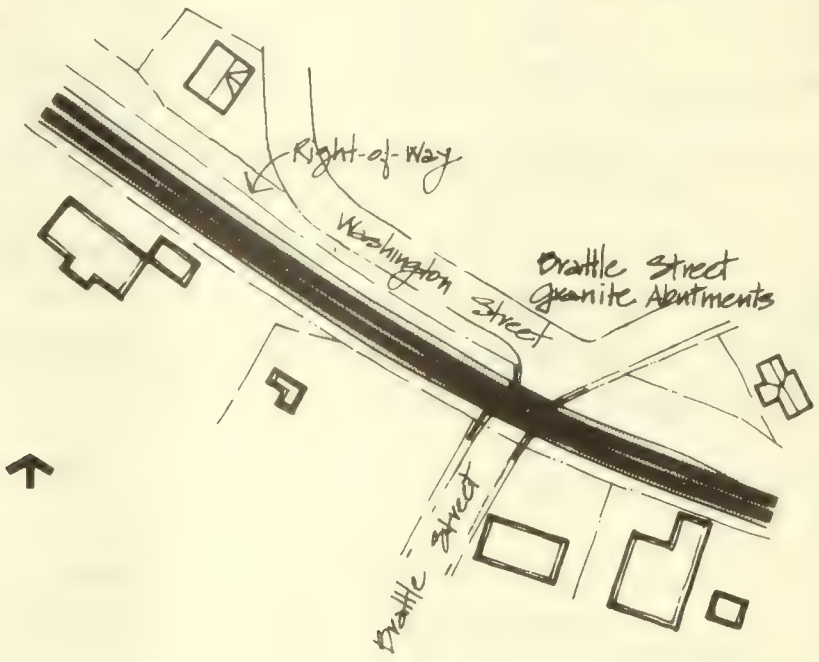
Granite retaining walls and steps were built here at the turn of the century when the railroad was regraded, creating the Brattle Street underpass. The stone blocks were laid with excellent workmanship. The Arlington Historical Commission has developed a classification system for Historic structures similar to that of the Cambridge Historical Commission. The four categories include: Primary Importance--those structures considered to be of striking historic value, both locally and nationally, including those listed on the National Register of Historic Places; Important--those structures only slightly less important or somehow altered from their original significance Moderately Important--those structures of value locally as representative of a certain architectural style or early period; and Mentionable--those structures

of only local interest as examples of fairly common early architectural styles or which have been greatly altered from their original condition. Mentionable rating has been given to the abutments.

Probable Impacts

The Brattle Street railroad abutments would be removed along with the embankment with construction of this portion of the Red Line. The granite stone which makes up the abutments will be saved and be reused as prescribed by the Arlington Historical Commission. A positive impact of removal of the abutments will be correcting the unsafe vehicular sight lines which presently exist at this underpass.

Alignment
under
Brattle Street



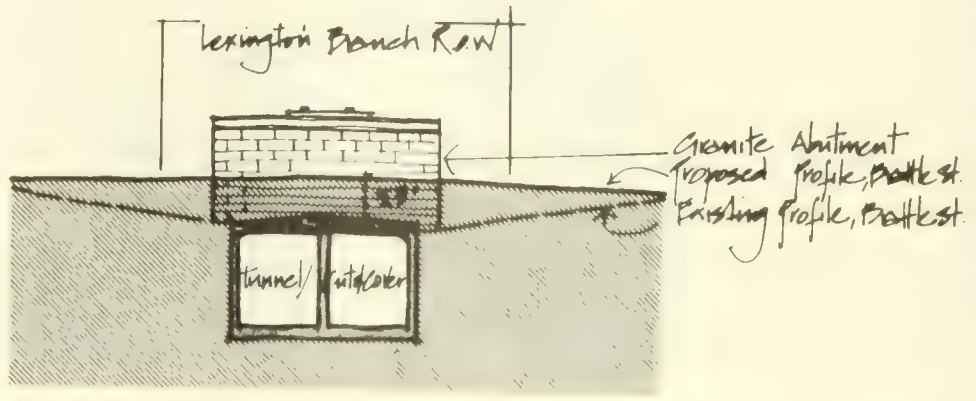
Alternatives

Any alternative which would place the proposed cut-and-cover tunnel underneath the underpass and specify construction techniques which would not require removal of the stone walls during construction would be substantially more expensive and do nothing to solve the roadway augment problem. Consequently, no prudent and feasible alternative exists.

Mitigating Measures to Minimize Harm

Prior to construction, the granite stones will be inventoried, disassembled and moved to a place of storage or a new site for reuse. The MBTA will assist the Arlington Historical Commission in formulating plans for reuse of the stone blocks. One possible use would be to use them to pave sitting areas developed along the proposed Linear Park.

Tunnel Section
at
Brattle Street



Summer Street Playground Area

Description and Use

The Summer Street playground area consists of 14.4 acres of land located on Summer Street between Washington and Forest Streets. It includes the combined recreational facilities of the Summer Street playground, Buck Field, and Hillis Hill.

The area was recently up-graded with partial funds supplied by the Bureau of Outdoor Recreation. Facilities include: a tot area, spray pool, two basketball courts (one lighted), baseball diamond, Little League diamond (Buck Field) and a wooded area (Hill's Hill).

This also is a tremendous recreational resource in Arlington. The area also includes the Veteran's Memorial M. D. C. Skating Rink which is located on leased land. In the spring the area is used for some junior high school physical education classes in the morning hours while the baseball diamond is used for school baseball and Buck Field is used for girl's softball. In the evening hours the Arlington Baseball Association and Little League use the ball fields while volleyball and basketball are played on the courts. In the Summer the area is a supervised playground for eight weeks. In 1976 the area will be used for a Day Camp site for 144 children for eight weeks. Evening hours, once again, are occupied by the Arlington Baseball Association and the Little League. In the Fall, flag football and soccer take over the afternoon and weekend hours. This coupled with extensive informal use by the citizenry make Summer Street a popular recreation spot. Summer Street playground is the major recreational resource in the Western part of Arlington. It too, is an integral part of the park system and should not be disturbed in any way which would detract from the area.

Auto access is fair, via Summer, Forest or Ryder Streets with some parking spaces available off Ryder Street by the MDC ice skating rink. Pedestrian access is important because of the youth orientation of the area. Many young people currently ride the Massachusetts Avenue bus to Forest Street and then follow Ryder Street over the at-grade railroad tracks. The railroad right-of-way is an important informal link to the Arlington High School grounds to the east and to the Arlington Heights area.

Summer Street Playground area is owed by the Town of Arlington and is under the jurisdiction of the Park Commission. The area was declared locally significant in a letter received from the Chairperson of the Park Commissioners, dated February 6, 1976.

Probable Impacts

No taking or use of any portion of the Summer Street Recreational Complex will be necessary for construction of the proposed project. Nor will any other long-term impacts affect the use of this facility because the subway will be in a covered tunnel as it passes by. The only potential impact would be short-term impacts relating to construction disruptions such as noise and dust. A positive impact will be the addition of new open spaces to this complex, increased accessibility, and a safer environment for small child play.

Mitigating Measures to Minimize Harm

During construction, dust and noise abatement techniques and policies will be initiated to control potential impacts. Protective measures such as 24-hour policing, fencing and warning devices will be used to ensure safe usage of the facilities during the construction period. Construction activities will be scheduled to minimize intrusions to activities occurring at the facilities.

Farm at 176 Lowell Street

Description and Use

These Victorian house, barn and outbuildings, constructed during the late 1800's, are the remnants of a market-garden farm. They have retained the naturalness of the pastoral setting amid the urban environment and are considered of Primary Importance as an historic resource.

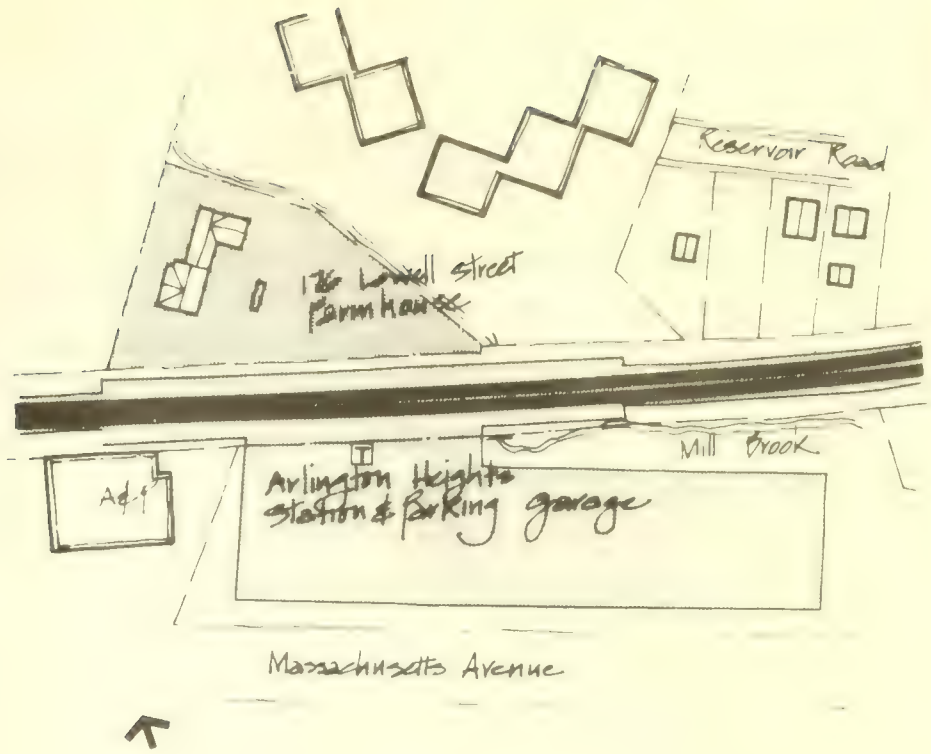
Probable Impacts

The main farmhouse structure, which will be approximately 90 feet from the centerline of the proposed alignment, could experience some perceivable vibration if the transit trackbed does not receive special treatment for noise and vibration reduction.

Presently, the farmhouse experiences extreme noise and vibration impacts resulting from intermittent passings of freight and commuter trains on the poorly maintained railroad roadbed. This condition, which can cause significant damage to the mortar and plaster of older buildings, would be eliminated.

Construction impacts would include noise and dust, both of which would be controlled by the various State and Federal regulations mentioned in this statement.

Alignment
at
Arlington Heights



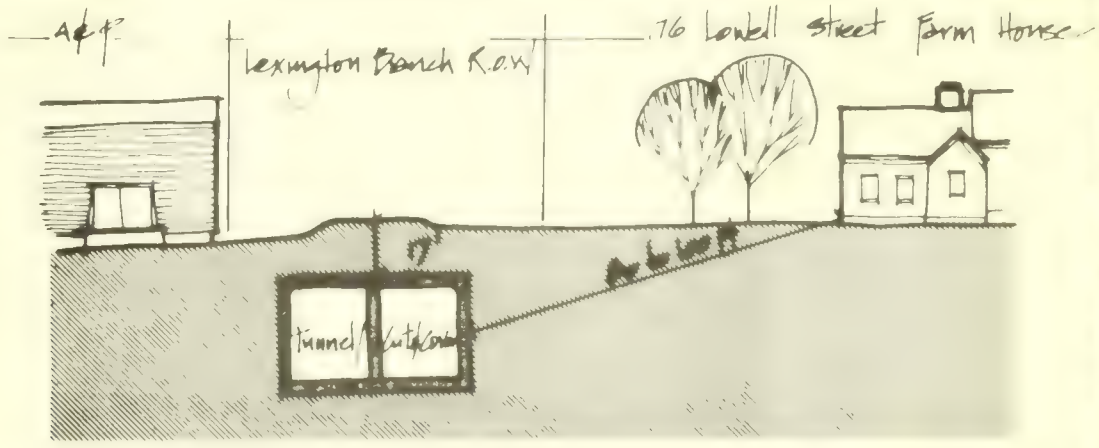
Alternatives

Shifting the project alignment and Arlington Heights Station further south of its proposed location to eliminate the minimal impacts to the farmhouse would require displacement of an A&P food market located along Massachusetts Avenue. This would result in long-term irreversible impacts--displacement of a structure, loss of employment and added costs.

Mitigating Measures to Minimize Harm

The visual impact of the proposed Arlington Heights Parking Garage would be minimized by landscaping the north side of the garage to screen it from view. Potential noise and vibration impacts would be reduced by special treatment of the trackbed. Types of special treatment are described in the Noise and Vibration Section of Chapter II.

Tunnel Section
at
Arlington Heights



Comments of Cambridge Historical Commission

In the course of evaluating the various alignments studied, the Cambridge Historical Commission provided an analysis of potential damage to historic structures and their response is included in this section. The Commission also responded to a draft version of this chapter and their comments are included in the following letter.

CITY OF CAMBRIDGE

CAMBRIDGE HISTORICAL COMMISSION

CITY HALL ANNEX, 57 INMAN STREET

CAMBRIDGE, MASSACHUSETTS 02139

Robert G. Neiley
Chairman

William B. King
Vice Chairman

Dwight H. Andrews
Arthur H. Brooks, Jr
James F. Clapp, Jr.
Charles W. Eliot, 2d

Hugh M. Lyons
Mrs. Charles M. Pierce
Joseph G. Sakey
Alternates

January 30, 1976

Domenic E. D'Eramo, P. E.
Sverdrup & Parcel and Associates
648 Beacon Street
Boston, Mass. 02215

Dear Mr. D'Eramo:

I am writing, as agreed at our meeting of January 14, to review the draft "Determination of Effect on National Register Properties" of the proposed extension of the MBTA's Red Line through Harvard Square and under Massachusetts Avenue to the Somerville line. The following is a result of consultation with Elizabeth Amadon, the State Historic Preservation Officer, and represents the Commission's position with regard to the plans as they have been formulated to date.

The Draft correctly states that the entire Cambridge Common and Old Harvard Yard Districts are on the National Register. As we pointed out at the meeting, all structures and features within or surrounding a National Register District must be given equal consideration to minimize adverse effects, and all new construction similarly falls within the 106 review process. We do not feel that the temporary adverse effects to be encountered during the construction phase are grounds for extensive revision of the project, although we expect that evidence will be provided to demonstrate that these effects have been minimized.

The demolition of the present Harvard Square kiosk and the construction of such features as new headhouses, bus ramps, and ventilating shafts are specific matters of concern. The State Historic Preservation Officer and I substantially agree that the kiosk cannot be removed if a feasible and prudent alternative to its destruction exists, although this does not mean that it must continue to be used for a station entrance. The statement in the Draft that the adverse effect of "Destruction or alteration of all or part of a property" will only be a factor during the construction period is incorrect.

I have investigated the possibility that significant archeological remains may lie in the path of the extension. It is my opinion that such remains will not be found, as almost the entire area to be disturbed for the excavation has either been a public way since the settlement of Cambridge or was dug up for the construction of the original subway. However, I expect that reasonable care will be taken in the event that unexpected remains are found.

As a procedural matter, I would like to point out that the Advisory Council procedures for review of the plans must be outlined in the draft E.I.S. These procedures, as well as the remaining steps in the review process with the Cambridge Historical Commission, the Massachusetts Historical Commission, and other public and private bodies has not, to my knowledge, been clearly outlined. In my opinion, the whole review process would be greatly facilitated if the steps that will be taken in this regard can be set out in detail.

I hope that these comments will be useful; please let me know if I can be of any further assistance.

Yours,

Charles M. Sullivan
Executive Director

CMS/dl

CC: Elizabeth Amadon,
Massachusetts Historical Commission
Kiyoshi Mano,
Urban Mass Transportation Administration

Comments of the Massachusetts Historical Commission

The Massachusetts Historical Commission was involved in evaluating the D-2 alignment with respect to its impact on the historical structures in the Harvard Square area and their comments are summarized in the following letter.

PAUL GUZZI
Secretary of the Commonwealth

The Commonwealth of Massachusetts
Office of the Secretary
Massachusetts Historical Commission
294 Washington Street Boston, Massachusetts 02108
(617) 727-8470

January 16, 1976

Mr. Domenic E. D'Eramo, P.E.
Sverdrup & Parcel and Associates
648 Beacon Street
Boston, Massachusetts 02215

Re: MBTA Red line extension from Cambridge to Arlington

Dear Mr. D'Eramo:

I am writing in response to your request for comments on our meeting which took place on January 14, 1976 and included representatives of Sverdrup and Parcel, the Massachusetts Bay Transportation Authority, the Urban Mass Transportation Administration, the Cambridge Historical Commission and myself as State Historic Preservation Officer and director of the Massachusetts Historical Commission. This meeting involved the review of the preferred alternative, D-2, for the above project.

I agree that of all the alternatives presented in the draft 106 Review, dated January 6, 1976, Alternative D-2 has the least adverse effect on historic properties. The only alternative which would cause no effect is "no build", an unacceptable choice as the need for the Red Line extension and improvements has been adequately demonstrated.

These comments apply only to the proposed plans and specifications as presented to us on January 14 and to designated Alternative D-2. If alterations are made in this alternative and as it is further developed, additional review will be necessary.

I would like to make the following requests and recommendations:
Cambridge
1) At Harvard Square, the reconstruction of the wall bordering Harvard Yard (in the National Register Historic District) should take place at the earliest possible time in the construction period.

2) The retention and reuse of the 1928 Subway kiosk, located at the junction of Massachusetts Avenue, Brattle and Dunster Streets in the center of the street, should be studied in depth. Any new construction located here is also subject to review for compatibility with the contiguous National Register historic district. I would like to request an opportunity for my review of this area of concern at the earliest study and design stage.

3) An engineering study should be made and all means taken to insure protection of the foundation and walls of the First Parish Unitarian Church (on the National Register).

4) In cooperation with the Cambridge Historical Commission and the Cambridge Conservation Commission, plans should be made for the type and location of any new trees to replace those which must be removed during construction in Flagstaff Park. Also, the location and design of the vent should be planned to meet the approval of the aforementioned commissions and myself.

5) The design of any street furniture and type and location of any trees removed during construction in the entire Harvard Square/Cambridge Common Historic Districts is subject to review by this office.

I recognize that there will be a short term adverse effect on the National Register districts during construction which cannot be mitigated but I also feel there is no prudent and feasible alternative to this effect. With proper review, the possible long term adverse effects can be removed or mitigated.

Arlington

1) The design of the proposed above ground subway station, located at the junction of Massachusetts Avenue, Pleasant and Mystic Streets, is subject to review for compatibility with the contiguous Arlington Town Center National Register Historic District. The Arlington Historical Commission and this office should be consulted at the earliest design stage.

2) The relocation of the commemorative plaque, now at the above junction, will not require my review, providing the Arlington Historical Commission is satisfied with the new location.

The above comments represent the consensus of agreement reached at the January 14 meeting. I recognize and commend the study which has gone into

January 16, 1976
Mr. D'Eramo

this project and appreciate the willing cooperation extended to the review agencies by everyone involved in the planning.

Sincerely yours,

Elizabeth Reed Amadon

Elizabeth Reed Amadon
Executive Director
Massachusetts Historical Commission
State Historic Preservation Officer

ERA/mw

xc: John McDermott, Advisory Council
Robert Neiley, Cambridge Historical Commission
Charles Sullivan, Cambridge Historical Commission
Ki Mano, Urban Mass Transportation Administration
George Wey, Massachusetts Bay Transportation Authority

Comments of the Massachusetts State Archaeologist

The following letter from the State Archaeologist states that no known archaeological sites exist in the proposed Harvard Square Station area.

The Commonwealth of Massachusetts

Office of the Secretary

State House, Boston 02133

John F. X. Davoren

Secretary of the Commonwealth

OFFICE OF THE STATE ARCHAEOLOGIST
BRONSON MUSEUM, 3 NO. MAIN ST.
ATTLEBORO, MA. 02703

Marion, Massachusetts
September 20, 1974

Sverdrup & Parcel and Asso. Inc.
648 Beacon Street
Boston, Ma. 02215

Att. D.E.D'Eramo
Project Eng.

Dear Sir :-

There are no archaeological sites of record in the area of the proposed Harvard Square Red Line subway extension in the Harvard Square section in Cambridge.

Thank you for the opportunity of checking this project.

Very truly yours,

Maurice Robbins

Maurice Robbins Ph. D.
State Archaeologist

Responses to MBTA's Requests for 4(f)
Determination of Significance

On July 21, 1975, the MBTA requested a determination of significance of the potential Section 4(f) lands under the jurisdiction of the Metropolitan District Commission and the Recreation Commissions of Cambridge, Somerville and Arlington. Copies of the responses follow.

PARK AND RECREATION COMMISSION
33 RYDER STREET
ARLINGTON, MASSACHUSETTS 02174
643-6700 EXT. 321-322

DANIEL F. BROSNAN, JR.
SUPT. OF RECREATION

COMMISSIONERS:
KEVIN P. FEELEY
JAMES W. FOWLER, 3RD
BERNICE JONES
JOHN A. JOHNSTON
JOANNE MOREL

February 6, 1976

Donald M. Graham, Project Manager
Northwest Red Line Project
M. B. T. A.
500 Arborway
Boston, Ma.

Dear Mr. Graham,

At the outset I would like to apologize for the delay in responding to this request. My original response on Thorndike and the Spy Pond areas along with visits from the De Leuw Cather & Co., I thought had explained the situation fully.

The Arlington Park and Recreation Commission has jurisdiction over the following parcels of land in Arlington: Fowles Pond Field, Warren A. Peirce Field (conjunctively with the School Committee), Magnolia Street, Summer St. playground, Buck Field, Hill's Hill and Hurd Field.

The areas listed are Park and Recreation areas in a densely populated community. These specific areas in Arlington are of prime importance since open space is a premium. The areas assume much more significance if the Red Line is constructed with the linear park concept.

Each area will be treated separately, however, each is significant in the overall park system in Arlington. The Arlington park areas are well spaced throughout the community to offer the residents playground areas within walking distance of their homes.

FOULE'S POND PLAYGROUND

3.5 acres located on Summer Street between Mill Street and Mystic Street. At present the area has a Little League baseball diamond, two tennis courts, a basketball court and playground equipment. The field is used in the Spring for girl's softball in the afternoons after-school and for Little League baseball in the evening. In the Summer the area is a supervised playground for eight weeks along with continued use at night for Little League and softball. In the Fall the area is converted to a PoP Warner football field which is used for games and practice sessions for Pop Warner football and the Recreation and School Department's flag football program.

Throughout this period the tennis courts and basketball courts are heavily used for informal play and in some instances league games and matches. In the Winter the courts are cleared for basketball and street hockey. In some cases, with ideal weather conditions, the area is flooded for ice skating. Needless to state, the area receives heavy use throughout the year.

WARREN A. PEIRCE FIELD

8.9 acres located at the rear of Arlington High School entrance area - Mill Brook Drive. This area is basically for physical education and high school sports for a 2,800 student populated public high school. The area is woefully inadequate for this many pupils which causes an over-use factor and the up keep of the area is difficult under these circumstances. In the Spring, in addition to physical education classes and high school baseball, softball and track, the area is used in the evening by the Little League and Arlington Baseball Association. During the Summer the area is used for playground activities as well as evening use for baseball, softball and basketball. In the Fall the physical education program during the day is held outside, whenever possible, followed by football and track practice. In the evening Pop Warner has football practice at the high school. Each season a total of between 30 and 35 football games are played on the grid-iron. This along with informal uses by residents make the Warren A. Peirce Field a popular recreation area. It is centrally located with the only running track in the community. School, recreation and informal use make Warren A. Peirce Field an integral part of the Arlington Park System.

MAGNOLIA STREET PLAYGROUND

150,500 sq. feet located on Herbert Road and Magnolia Street. This area is at present undeveloped. The area related to the Thorndike railroad right of way and Thorndike Field makes an excellent recreational resource. It is located in a densely populated two family home neighborhood. It will be part of the six year capital outlay program in fiscal year 1978. Potentially the area is a tremendous open space park resource.

SUMMER STREET PLAYGROUND

Includes Buck Field and Hill's Hill, 14.4 acres located on Summer Street between Washington and Forest Streets. The area was recently up-graded with partial funds supplied by the Bureau of Outdoor Recreation. Facilities include: a tot area, spray pool, two basketball courts (1 lighted), baseball diamond, Little League diamond (Buck Field) and a wooded area (Hill's Hill).

This also is a tremendous recreational resource in Arlington. The area also includes the Veteran's Memorial M. D. C. Skating Rink which is located leased land. In the spring the area is used for some junior high school physical education classes in the morning hours while the baseball diamond is used for school baseball and Buck Field is used for girl's softball. In the evening hours the Arlington Baseball Association and Little League use the ball fields while volleyball and basketball are played on the courts. In the Summer the area is a supervised playground for eight weeks. In 1976 the area will be used for a Day Camp site for 144 children for eight weeks. Evening hours, once again, are occupied by the Arlington Baseball Association and the Little League. In the Fall flag football and soccer take over the afternoon and weekend hours. This coupled with extensive informal use by the citizenry make Summer Street a popular recreation spot. Summer Street playground is the major recreational resource in the Western part of Arlington. It too, is an integral part of the park system and should not be disturbed in any way which would detract from the area.

HURD FIELD

4.5 acres located on Mass. Ave., off Drake Road. Hurd Field serves as the community's only lighted softball field. With the great demand on play-fields the use of Hurd at night eases the load in the twi-light hours. In the Spring the area is used for girl's softball in the afternoons; the Little League at night and on the weekends and after dark by the Recreation Division's men's and women's softball program. The same applies in the Summer months while in the Fall the area is used for flag football, soccer and touch football, sponsored by the Recreation Division. Hurd blends in nicely with the surrounding Reservoir area and will be up-graded in the near future to improve the whole Reservoir complex.

The situation with the other areas previously described has not substantially changed since I last described them.

Hope this information is sufficient.

Sincerely,

Daniel F. Brosnan

Daniel F. Brosnan, Jr.
Supt. of Recreation

DFB/l

cc: Alan McClennen

CITY OF CAMBRIDGE

CAMBRIDGE, MASSACHUSETTS 02139
Tel. 876-6800

EXECUTIVE DEPARTMENT
JAMES L. SULLIVAN
City Manager

August 16, 1976

Mr. Donald M. Graham
Manager of Master Planning
MBTA
500 Arborway
Boston, MA 02130

Dear Mr. Graham:

This is in response to your letter of July 21, 1975 seeking re-affirmation of the significance of three parklands, under the jurisdiction of the Cambridge Recreation Commission, for designation as Section 4(f) lands.

The Fresh Pond Reservation and an adjacent golf course and soccer field are used even more intensively now than as previously reported in November of 1972. This is also the case for Russell Field and Rindge Field. These two facilities are used extensively by school athletic teams as well as the general public.

The City of Cambridge considers these facilities vital to the delivery of open space and recreation services to citizens of Cambridge.

Sincerely yours,

James L. Sullivan,
City Manager

cc: Conrad Fagone
William McGinness
Paul Cowles

The Commonwealth of Massachusetts
Metropolitan District Commission
20 Somerset Street, Boston 02108

April 28, 1977

Mr. Donald M. Graham
Project Manager
Northwest Red Line Project
Massachusetts Bay Transportation Authority
500 Arborway
Boston, Massachusetts 02130

Dear Mr. Graham:

Your letter of July 21, 1975 raised the possible applicability of Section 4(f) of the U.S. Department of Transportation Act of 1966 to certain properties under the jurisdiction of the Metropolitan District Commission in the area of Alewife Brook. This is in connection with plans by the Department of Public Works and the Massachusetts Bay Transportation Authority to undertake federally assisted transportation improvements.

From the proposed plans developed during the past eighteen months, it is now clear that the specific area under the jurisdiction of the M.D.C. to be used for or impacted by the proposed improvements lies at the intersection of the communities of Arlington, Belmont and Cambridge as shown on the attached plan (Attachment 1). The area generally includes the Dewey and Almy (Route 2) Circle northeasterly along Alewife Brook Parkway southerly to the intersection of Rindge Avenue and the area surrounding Alewife Brook including Yates Pond bounded by Route 2, Alewife Brook Parkway, the Boston and Maine Freight cutoff running east-west on the southerly side of the area, and the property owned by Arthur D. Little, Inc. We understand that the project area for the proposed improvements is larger than the area described, but the area described represents the total area under the control of the Metropolitan District Commission which will be either used or potentially affected by the proposed transportation improvements.

Certification of Jurisdiction

The Metropolitan District Commission hereby certifies that it does exercise jurisdiction over the land in question. This property was acquired by the Metropolitan Parks Commission in 1908, and has been under the jurisdiction of the M.D.C. since 1919. While legislation enacted in 1951 (Chapter 491) limits the ability of the Commission to dispose of a portion of the property, the land remains under the jurisdiction of the Commission (see below).

Finding of 4(f) Category - Public Park

As an addition to the Metropolitan Parks System (which was established in the 1890's), the land in question was viewed as establishing a linkage between the Mystic River Reservation to the north and the Fresh Pond - Charles River

Reservations to the south. As early as 1897, in the ''Diagram of the Parks and Parkways of the Boston Metropolitan District', contained in the reports of the Metropolitan Park Commission, this area is specifically designated as one needed to complete the park reservation system. The Report of 1898 discusses the need for a park acquisition in the Alewife area, and relates this proposed acquisition to the reservation system as a whole. In 1904 the legislature directed that a study be prepared, providing a method to purify Alewife Brook and the surrounding lands, and further directing that the recommendations of this study be made "with due regard...to the plans of the metropolitan park commission for park developments within the said region...". This integration of park development and sanitary improvements reflected an established Park Commission philosophy first outlined in the Report of 1893, in the section on "Sanitary Improvements promoted by Recreative Treatment..." (p. 18-19). In the Report of the Metropolitan Park Commission of 1909 (the year after the Commission acquired the land) the 'Diagram of the Public Open Spaces of the Boston Metropolitan District' places the Alewife lands in the same category as the Blue Hills, the Middlesex Fells, and other major reservations of the Park Commission.

The Metropolitan District Commission was created in 1919 to combine the Park Commission, the Metropolitan Water Board and Metropolitan Sewerage Board and succeeded to the interests of the Metropolitan Park Commission. The Metropolitan District Commission now controls 15,000 acres of parkland in metropolitan Boston. Thus the land to be affected has been under the jurisdiction of a public park agency for seventy years. More recently, this land was included in a list of 36 parks and reservations formally designated as such by vote of the Metropolitan District Commission at its meeting of December 18, 1974. There can therefore be no question that the land to be impacted is a "public park" within the meaning of Section 4(f).

Finding as to "Significance"

Despite the long history of the land in question as public parkland, the land has been dominated by ever increasing transportation uses since its acquisition. The five major transportation uses in the immediate area are as follows:

1. Route 2 and the "Dewey and Almy Circle" bisect the Parkway and the land in question in an east-west direction. Route 2 is the major state highway from the northwestern suburbs to Boston. It is a limited access four-lane highway at this point and carried an average daily traffic (ADT) volume of 44,500 in 1975. Alewife Brook must pass under the highway through a culvert which has for years effectively severed the continuity of the brook and adjacent land.

2. The Boston and Maine Railroad Lexington Branch is a 66-foot right-of-way which bisects the land in question on a north-south alignment. The roadbed stands substantially above the natural contour of the parkland below and breaks the continuity of the land area on the opposite axis from the highway (c.f. above). The right-of-way existed prior to the time the park was acquired by the Metropolitan Park Commission and has been one of the continuing impediments to any park development of the area.

3. The Boston and Maine Railroad Freight cutoff runs on an east-west alignment and provides most of the southern boundary for the area in question except at the easterly end where it bisects the parkway segment and necessitates a high level

bridge over the railroad which has a substantial negative impact on the contour of Alewife Brook Parkway.

4. A paved parking lot comprising approximately 4.5 acres under lease to an abutting business (Arthur D. Little Co.) occupies the entire west end of the land in question. The land was natural low land and was filled and paved in the early 1960's when the lease originated. The lot is used to park approximately 350 cars on a daily basis.

5. Alewife Brook Parkway itself is a major transportation link which in 1975 had an average daily traffic (ADT) volume of 48,900 in this area. Because of its location between Massachusetts Avenue at the Arlington-Cambridge line and Concord and Huron Avenues in Cambridge, connecting to Route 2 West in the mid-section, this section of Alewife Brook Parkway is heavily used by commercial traffic, and is not restricted, like mose parkways, to pleasure-vehicles-only. This section of the parkway is dominated by the Route 2 circle and numerous commercial and industrial abutters, including chemical production, metal products, an automobile dealer, gas stations and a fast-food drive-in.

Section 4(f) of the Department of Transportation Act of 1966 as it appears in Title 23, USC provides:

> "It is hereby declared to be the national policy that special effort should be made to preserve the natural beauty of the countryside and public park and recreation lands, wildlife and waterfowl refuges, and historic sites. The Secretary of Transportation shall cooperate and consult with the Secretaries of the Interior, Housing and Urban Development, and Agriculture, and with the States, in developing transportation plans and programs that include measures to maintain or enhance the natural beauty of the lands traversed. After the effective date of the Federal-Aid Highway Act of 1968, the Secretary shall not approve any program or project which requires the use of any publicly owned land from a public park, recreation area, or wildlife and waterfowl refuge of national, State, or local significance as determined by the Federal, State, or local officials having jurisdiction thereof, or any land from an historic site of national, State, or local significance as so determined by such officials unless (1) there is no feasible and prudent alternative to the use of such land, and (2) such program includes all possible planning to minimize harm to such park, recreational area, wildlife and waterfowl refuge, or historic site resulting from such use."

The Commission understands that the prohibitions and procedures set forth in Section 4(f) do not prohibit the use of all public parkland, but only that of "national, state or local significance...". Although the ultimate determination of "significance" may be made elsewhere, Section 4(f) clearly provides that the threshold determination of "significance" is to be made by the agency having jurisdiction of the land in question. This places on the agency having jurisdiction the responsibility to distinguish between those public parks which are "significant" and those which are not, so as to carry out the spirit as well as the letter of the federal policy of parkland protection.

In considering the question of "significance", the Commission reviewed the data and the descriptions outlined above, and concluded that this area was already a major regional transportation node, and that the significance of the parkland in question has been seriously undermined by the domination of these transportation uses. The significance of this land has been further compromised by state legislation (Chapter 491 of the Acts of 1951) enacted fifteen years in advance of the adoption of Section 4(f). Chapter 491 authorizes and directs the transfer of a major portion of the park land in question to the, then, Metropolitan Transit Authority upon passage of further legislation, but forbids any alternative disposition of the area in the intervening period. This legislation distinguishes the land in question from any other park land in the metropolitan park system in that it is the only pre-4(f) legislation which expresses the intent to transfer a parcel of park land to another use in the future.

For all the reasons set forth above, the Commission by vote at its regularly scheduled meeting of April 7, 1977 made the determination that the land in question, while it is park land, is not "significant" within the meaning of Section 4(f) of the U.S. Department of Transportation Act of 1966.

Hydrology

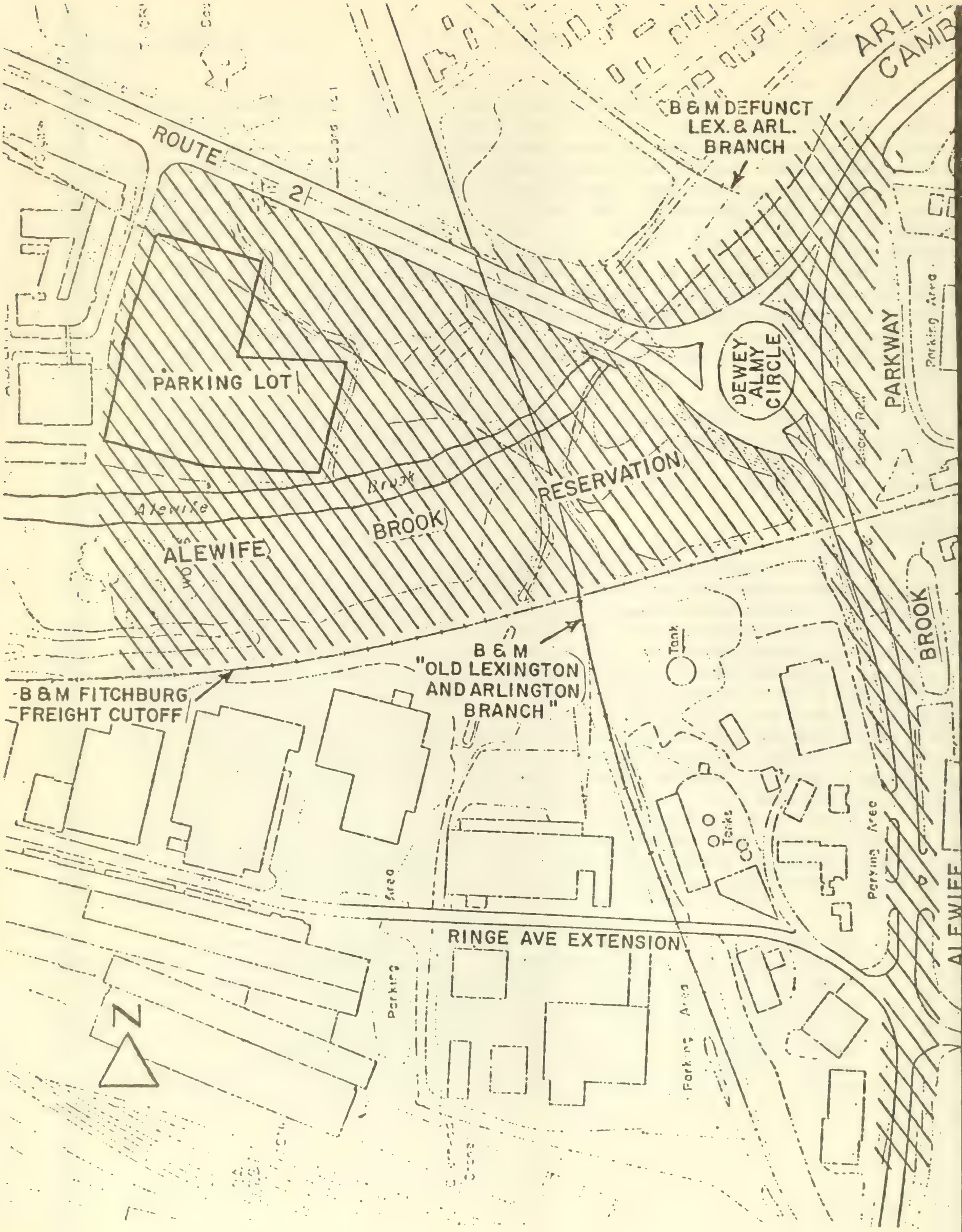
During its consideration of this question, the Commission gave serious attention to the opinions expressed by environmental groups and many members of the public. Concern was repeatedly voiced for the hydrological problems of the Alewife area, and for those parts of the reservation in particular which are wetlands or flood storage areas. Although these issues are definitely outside the formal limits of Section 4(f), the Commission agrees that they are of great importance. We have, therefore, undertaken a hydrology study of the entire Mystic River Watershed of which Alewife Brook is a part, and believe that this study will guide any hydrological alterations in this area. In the design of the transportation improvements intended for this area, the agencies involved have striven to minimize impacts on the wetlands, and to maintain the flood storage capacity of the area.

I hope that this responds adequately to your inquiry concerning the 4(f) status of M.D.C. land in this area. If the Commission can provide any additional information, please do not hesitate to call on us.

Sincerely yours,

John F. Snedeker

JOHN F. SNEDEKER
Commissioner


ROUTE 2
B & M DEFUNCT LEX. & ARL. BRANCH
PARKING LOT
DEWEY ALMY CIRCLE
PARKWAY
RESERVATION
Alewife Brook
ALEWIFE
BROOK
B & M "OLD LEXINGTON AND ARLINGTON BRANCH"
B & M FITCHBURG FREIGHT CUTOFF
RINGE AVE EXTENSION
Tank
Tanks
Parking Area
N

CONSTRUCTION IMPACTS

Air Quality

Air quality impacts would result from dust generated by equipment movement, construction equipment emissions and from vehicular emissions due to increased traffic congestion. Ameliorative measures for these impacts include dust control through watering and covering procedures, emission control devices for construction equipment, and traffic maintenance procedures. All such local and state requirements governing construction activities will be met.

Accurate assessment of air quality impacts from construction activities is not possible because: (1) the activity factors (counterparts to vehicle miles of travel for highway vehicles) are poorly defined; and (2) emission factors for some of the major emissions (e.g., re-entrained dust) are inaccurate or unavailable. Nevertheless, the following qualitative points can be made about the construction phase of the project:

- Most current construction equipment is diesel-powered so emissions of hydrocarbons and carbon monoxide will be somewhat less than for an all gasoline-powered equipment case.

- The equipment density will be low relative to motor vehicle traffic, and pollutants should be well-dispersed.

- Proper application of water to roadways and covering of aggregate piles when not in use will do much to reduce particulate matter from such sources.

Although it is not possible to completely eliminate air quality problems during construction, good "housekeeping" can greatly moderate the impacts. Adherence to local and state regulations should prevent violation of state or federal ambient air quality standards. Some short-term deterioration of air quality may occur, but this can be viewed in the context of a trade-off for improved air quality on a long-term basis.

The Contract Specifications will require the contractor to comply with all local, state and federal air pollution control laws, codes and regulations.

Construction Noise and Vibration

Construction is one of the major noise sources in urban areas. Building construction of public works projects, coupled with traffic, have created an almost perpetual din in many cities. The noise from the construction of a rapid transit system can disturb quiet areas and further impact those already subjected to excessive noise. Many of the machines and techniques commonly used in tunnel construction produce high levels of noise and residents near the construction site may be exposed to such activity for time periods of more than a year. Poorly maintained equipment can cause additional disruption. It is not uncommon to see unmuffled compressors, backhoes, trucks and other heavy equipment being used in urban areas.

Construction equipment need not be excessively noisy. As is shown in Appendix D, quiet versions of many machines are available. In response to pressures placed on them by local noise ordinances and by construction noise specifications in contract documents, many contractors are buying and using quieted machines. The construction phase is demonstrably less disrupting to people wherever such machines are used.

Another way in which to reduce excessive noise levels during the construction phase is to consider noise and vibration during the planning and staging of construction operations. In some situations noisy operations can be placed in nonsensitive locations, or a noisy operation can be replaced by a quieter operation which accomplishes the same purpose.

For the Red Line Extension, contractors will be asked to take noise into account in their construction techniques and will be required to comply with the guidelines for construction noise described in Appendix D. The result of such action will be less than usual construction noise on the entire project.

Ground Vibration from Tunneling

Ground vibrations during the construction phase of transit systems may result from a number of operations, among which the most critical is deep bore tunneling in rock. Deep bore tunneling is planned between Harvard Square and Davis Square, but ground vibrations should not be a problem in most locations because the tunnel will be driven through rock and soft ground. Vibrations from other construction sources which impact the ground surface, such as pavement breaking and pile driving, may be perceptible to distances of 200 feet from the site, but should cause no damage to residences further than 15 feet from the location of usage.

Siltation and Erosion Control

Steam siltation is a potential adverse impact at Alewife and Mill Brooks, but it is not expected to affect fish breeding. Erosion control techniques and the use of sediment basins would minimize this occurrence. Other potential negative effects, such as disruptions to recreational or historic resources, have received careful consideration. The project has been modified or protective measures introduced as needed; no additional unavoidable adverse impacts are presently anticipated.

As a standard procedure to control certain construction impacts, the MBTA requires all contractors to follow the provisions of Massachusetts Department of Public Works Standard Specifications for Highways and Bridges, Section 7.02, entitled "Prevention of Water Pollution--Sanitary Provisions."

In general, the specifications require the contractor to submit and receive approval for a detailed erosion control plan prior to proceeding with construction. The specifications also require either the engineer (the MBTA), or the contractor to:

- restrict the amount of surface area that can be exposed;
- employ efficient scheduling of clearing and grubbing operations relative to grading and excavations;
- provide for rapid seeding and mulching of slopes; and

- prohibit deposition of excavated materials in or near streams or lakes where entry into the water is probable.

Other construction practices are to be employed, as needed, to prevent or minimize siltation or pollution of the aquatic environment.

Features recommended for erosion control plans, in addition to the standard specifications, include installation and stabilization of all structural control measures (berms, dikes, etc.) prior to any other grading, clearing or disturbance of existing surface; protection of storm sewer inlets with hay bales or other silt filters or traps; and regular maintenance and cleaning of the erosion control measures. Conscientious integration of the appropriate temporary and permanent erosion control features with proper maintenance and "housekeeping" of construction site facilities will minimize erosion, prevent serious damage in the event of flash flooding and reduce the potential of water quality contamination due to common construction materials such as concrete wash, petroleum products, pesticides, cleaning solvents and other construction chemicals.

Contractors are required by Section 7.02 to control pollutants associated with common construction materials or operations which may be contributed to run-off water. Potential pollutants include pesticides, petrochemicals, solid wastes, construction chemicals (masonry acids, concrete curing compounds), wastewater from cleanup operations, lime, sanitary wastes and fertilizers. Many of these toxic materials can be controlled through normal sediment and erosion control procedures. Proper handling of these materials, appropriate site maintenance and adequate disposal of facilities also help to minimize pollution from construction activities.

Traffic Disruption

Traffic disruptions would occur primarily in the areas immediately surrounding the stations and would include delays due to congestion, detours onto local streets and restricted vehicular access to some businesses. These would be minimized through judicious construction staging and temporary decking aimed at maintaining the existing vehicular capacities. Traffic circulation, street and intersection closures, and parking accommodations would be designed to limit intrusion into neighborhoods adjacent to the station areas. Scheduling of construction activities would be coordinated with the contractors, local police, fire and utility departments, affected

retailers and other businesses, and other concerned agencies and organizations. All access, including service trucks, to residences and businesses will be maintained.

Effect on Existing Structures

Figure II-6 illustrates the assumed area that could be affected by subsurface construction whether by tunneling, cut-and-cover or open-cut methods, and indicates where ground settlements could take place. The maximum settlement expected from tunneling in soft ground might range from three to six inches at the centerline between the two tunnels; some distance away from the centerline this would be reduced to zero. About 20 percent of these estimated settlements would be due to stress relieving and readjustment of the soil and the remainder would result from construction techniques. No settlement is expected from tunneling in rock. Maximum settlement from cut-and-cover or open-cut excavations are expected to be three to six inches; lowest in sandy soils and highest in clays.

The potential damage to an existing structure as a result of subsurface construction depends on type, construction, age and existing condition of a building or utility, and the differential settlement anticipated. Differential settlement refers to a condition where the soil at one point around a building foundation settles more than at another point, thus causing an angular distortion. Some buildings, such as wooden structures, can undergo certain amounts of distortion without detrimental effects. Other buildings which are sensitive to distortion must be protected by underpinning or other construction techniques.

Figure II-6 indicates the subdivision of the "zone of influence" into two segments. Within Zone A, structures must be protected from excessive distortion by underpinning or the construction of a cut-off wall within the zone. Structures in Zone B should undergo less distortion, but could suffer some minor damage. Rigid construction specifications will be necessary to minimize, as much as possible, any settlement due to construction.

There is no certainty that a structure will be unaffected by a tunneling operation beneath it. Methods are available, however, to prevent distortion tolerances from being exceeded. The use of such methods, in conjunction with a strict monitoring system, will ensure that settlements will be limited to a degree which is not detrimental.

Based on data available to date, no buildings will require underpinning. Cut-off and/or slurry wall construction is the technique expected to be utilized for building protection. With this technique, no effects are anticipated on existing structures such as the residential buildings along the railroad rights-of-way.

In the final phase of design and prior to actual construction, more detailed soils and buildings analyses must be made. This will include a complete survey of all existing structures along tunnel routes and the recording, by measurement and photographs of all existing conditions. The soils analysis will determine the shear strength properties of the soils. From this data, a complete settlement profile will be developed for the specific locations. Based on the estimated strains and displacements, the influence of these movements on existing structures can then be evaluated.

Water Table

The groundwater table would be within the limits of construction for the entire alignment. Most groundwater areas could be controlled by dewatering; however, recharging of groundwater may be necessary.

Underground Stream

The potential exists that an underground stream could be encountered during construction. The problem presented by such an occurrence is two-fold: 1) effect of the stream on the actual tunnel construction and 2) effect of the construction (permanent and temporary) on the underground flow. In the first case, there are techniques to deal with the problem such as cut-off walls (e.g. slurry-trench walls), deep wells, well points and jet educators. The system that would be utilized depends on the ground flows. The location of the construction within the acquifer (stream) determines what effect it will have on the flow. Can the stream flow above and below the construction? Does the construction create a dam or stop water flow? The resolution of this problem will probably require more extensive explorations and study. Placing a gravel and sand layer around the tunnel can create a syphon or flow under or over the tunnel. This is one method that could be used in the event of encountering an underground stream.

Flash Flooding

Flash flooding of the tunnel excavation during construction presents two problems: (1) can the storm drainage system handle this additional flow; and (2) if the water is pumped into the drainage system, what can be done to remove eroded material? Each case would depend on the location. If the area allows, a settling basin perhaps could be constructed say between Davis Square and Arlington Heights. Pumping into a storm drain will have to be controlled so that sewer capacity is not exceeded. Silts could be removed by allowing material to settle in the excavation before it is pumped out.

Utilities

All utilities will be relocated and maintained during construction. Plans will be coordinated with all utility companies. Construction procedures will be developed that are acceptable to these utility companies.

Major utilities cross the path of the proposed transit line at numerous locations in Cambridge, Somerville and Arlington. While many of these utilities will not create serious relocation problems, others will involve substantial work. In Cambridge, at Harvard Square and Porter Square, it will be necessary to relocate a number of water lines including a 48-inch diameter MDC water line. In addition, a 30- by 41-inch sanitary sewer and a 60-inch combined sewer will be relocated at Massachusetts Avenue and the Fitchburg Freight Cutoff. At Davis Square in Somerville, a three-foot brick sewer will be relocated as well as a 48- by 52-inch storm drain along a railroad right-of-way. A Boston Edison 345 Kv transmission line crosses at Thorndike Street in Somerville.

In Alewife, it will be necessary to relocate an existing Algonquin Gas Transmission Company main line just north of Route 2, 48" combined sewer, the MDC's Alewife Brook conduit and support a Boston Edison 345 Kv transmission line.

In Arlington, two MDC sewer lines between Mill and Water Streets, a 16-inch high pressure gas line at Grove Street, and a MDC water line just beyond Grove Street will be relocated.

It will be necessary to relocate two MDC sewer lines at the proposed Arlington Heights Station. It will also be necessary to alter the existing location of Mill Brook.

Disposal of Excavated Materials

During the construction of the below-grade segments of the project, large quantities of soil and rock will be excavated and then hauled from the site by truck or railroad car to be disposed of at a site or sites located within the metropolitan area. Identification of potential disposal sites will occur during the initial engineering phases for the project, at which time more detailed information about the amounts and types of excavated materials will become available. Actual selection of the disposal site or sites will not take place until after construction contracts are bid and a contractor is subsequently chosen. At that time, the Authority can either specify which disposal sites are to be used or grant approval to use those sites proposed by the Contractor.

It is presently anticipated that excavated material will be utilized to convert the former Cambridge City Dump into a recreational facility. Other potential uses are raising the level of Russell Field to improve drainage. This is at the request of the Cambridge Recreation Commission. The Town of Arlington has indicated that some of the excavated material could be used in improving the presently unimproved Magnolia Street Playground. Agreements will be negotiated as the project develops.

Any site which is selected for disposal of excavated materials must be approved by state and local agencies. Permission to use these areas will only be granted after it has been demonstrated that filling operations at the site will not have a detrimental impact on the surrounding environment. Under the provisions of the Wetlands Act of 1974, all wetlands, floodplains, lakes, streams, etc., and bordering lands are protected against arbitrary filling, and any attempt to alter or build them up must be approved by the Department of Natural Resources and the local Conservation Commissions.

Operating procedures at a disposal site are regulated by Sections 7.02 and 150.21 of the Massachusetts Department of Public Works' Standard Specifications for Highways and Bridges. The MBTA has committed itself to disposal at sites approved by the Department of Environment Quality Engineering (DEQE).

Table II-36 shows approximate amounts of the excavated material for the project by line segments and station areas.

Table II-36

ESTIMATED EXCAVATED MATERIALS

Segment/Station Area	Amount (Cubic Yards)
Harvard Square	94,000
Harvard Square to Porter Square	96,000
Porter Square Station	53,000
Porter Square to Davis Square	71,000
Davis Square Station	48,000
Davis Square to Alewife	139,000
Alewife Station	50,000
Alewife to Arlington Center	290,000
Arlington Center Station	45,000
Arlington Center to Arlington Heights	541,000
Arlington Heights Station	47,000
Total	1,474,000

Using the limited soils information available, an estimate was made of the types of excavated material that might be expected during construction of the Project. (See Table II-37.)

Table II-37

ESTIMATED EXCAVATED MATERIALS
BY SOIL TYPE

Material	Amount (Cubic Yards)
Fill	290,000
Sand and Clay	120,000
Clay	114,000
Till	38,000
Rock	358,000
Sand and Gravel	554,000
Total	1,474,000

As previously stated, the reuse of this material to reclaim a dump as a recreational facility, improve an "unimproved playground", and improve drainage conditions at an existing field are being negotiated with appropriate local officials. This is one method to recycle these natural resources. Other means to recycle this material may develop in the more detailed analysis that will take place following the completion of the soils investigation and the development of construction staging plans.

Spillage

According to the Massachusetts General Laws, no vehicle shall be driven on any way, unless such vehicle is constructed or loaded so as to prevent any of its load from dropping, sifting, leaking or otherwise escaping from the vehicle.

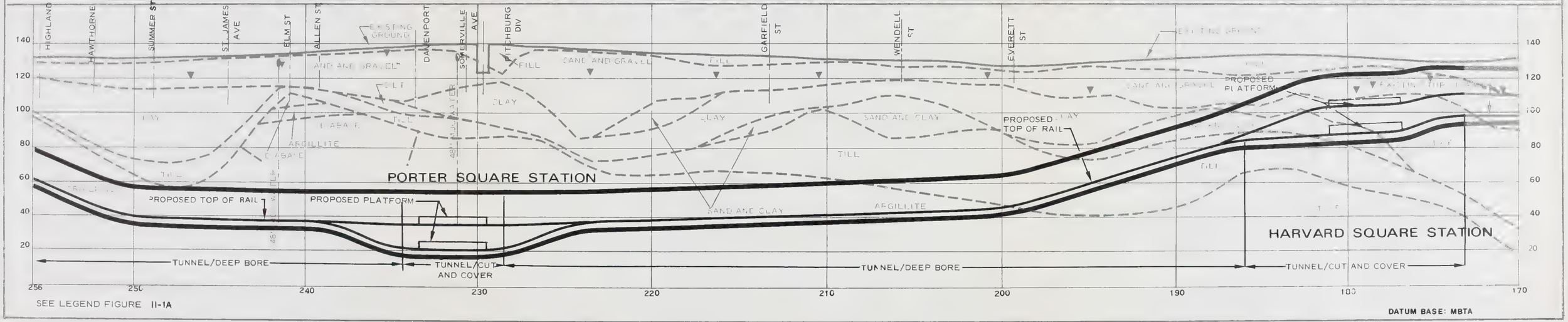
LEGEND

	TUNNEL/ DEEP BORE AND TUNNEL/ CUT & COVER
	STATION PLATFORM
	RECREATION AREA
	M.D.C. RESERVATION
	WETLANDS
(4)	DISPLACED DWELLING UNITS (NUMBER)
	NOISE MEASUREMENT
	VENTILATION AND EMERGENCY SHAFT LOCATION
(2)	DISPLACED BUSINESS (NUMBER)
*	HISTORIC RESOURCE
□	STRUCTURES REQUIRING SPECIAL PROTECTIVE MEASURES
C	CHURCH/ CEMETERY
P	POLICE
F	FIRE
ES	ELEMENTARY SCHOOL
SS	SECONDARY SCHOOL
▼	WATER TABLE
	STATION POINT

RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

LEGEND

FIG. II-1A



SEE LEGEND FIGURE II-1A

DATUM BASE: MBTA

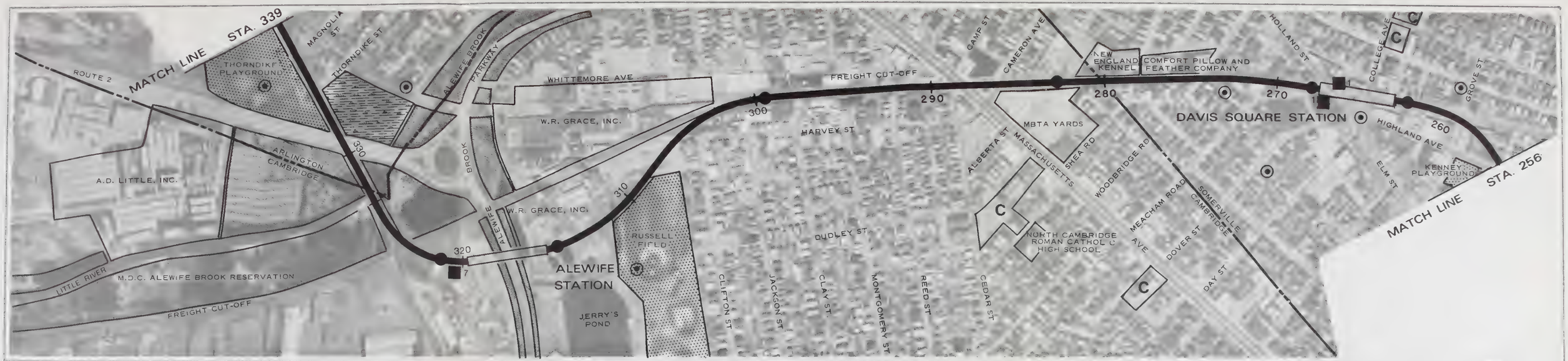
RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

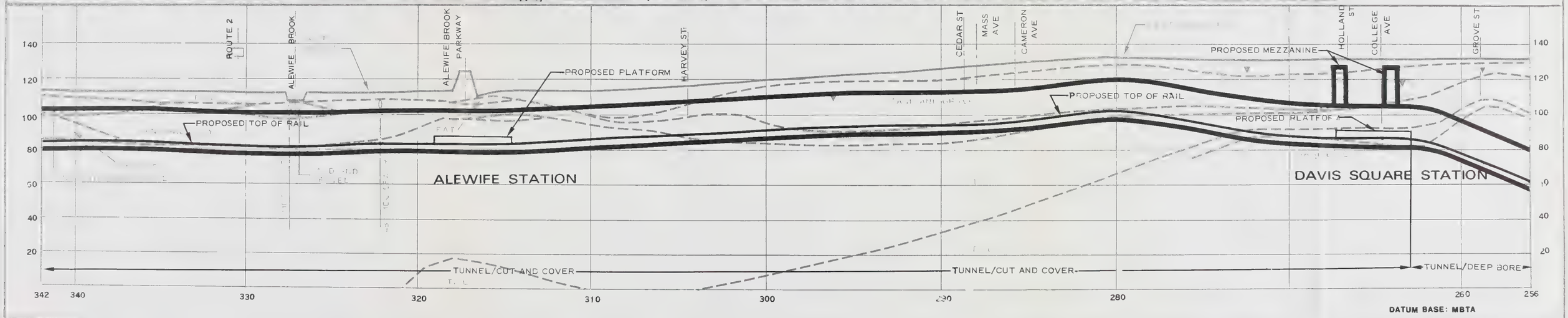
PROJECT ALIGNMENT

PROFILE AND ENVIRONMENTAL RESOURCES

HORIZ 0 100 200 FEET 400 VERT 0 5 10 20 FEET 40

FIG. II-1B





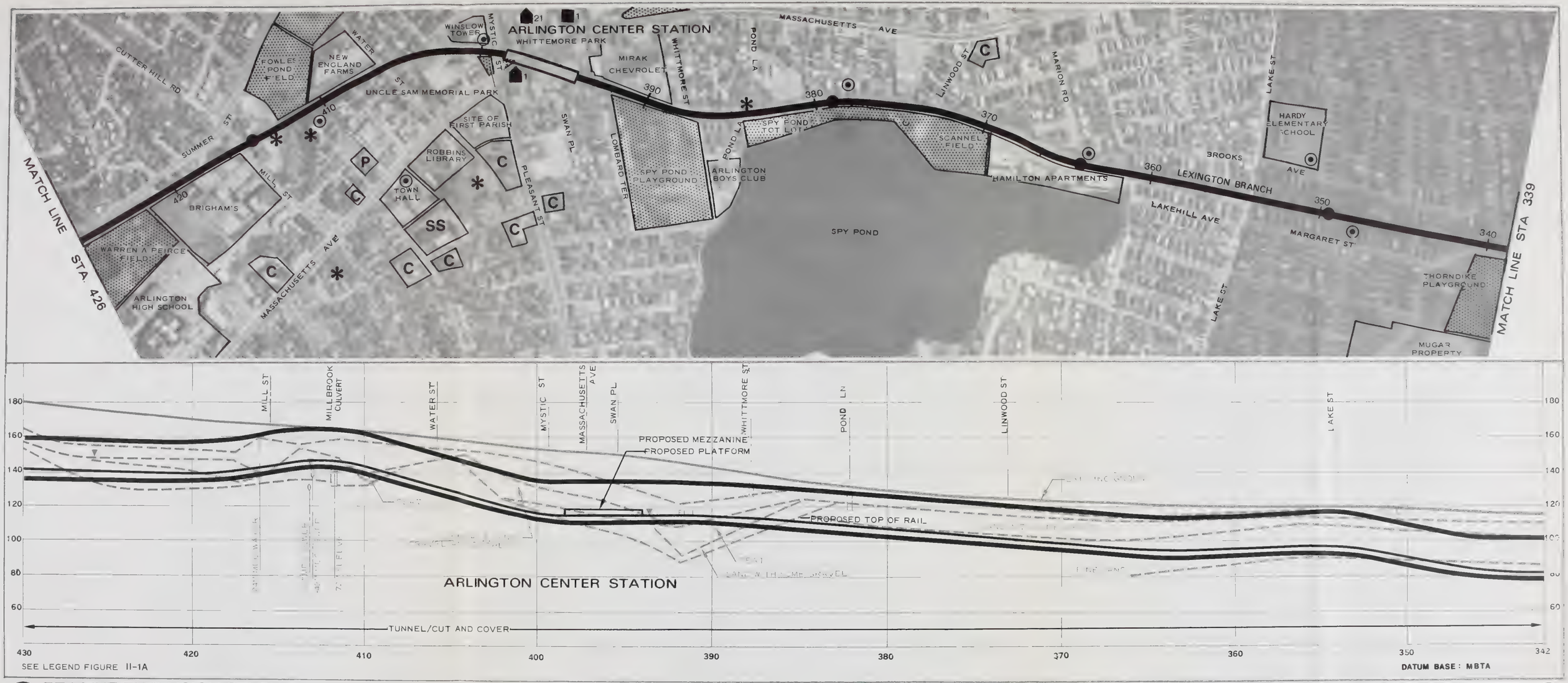
HORIZ 0 100 200 400 FEET VERT 0 5 10 20 40 FEET

FIG II-1C

PROJECT ALIGNMENT

PROFILE AND ENVIRONMENTAL RESOURCES

RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority



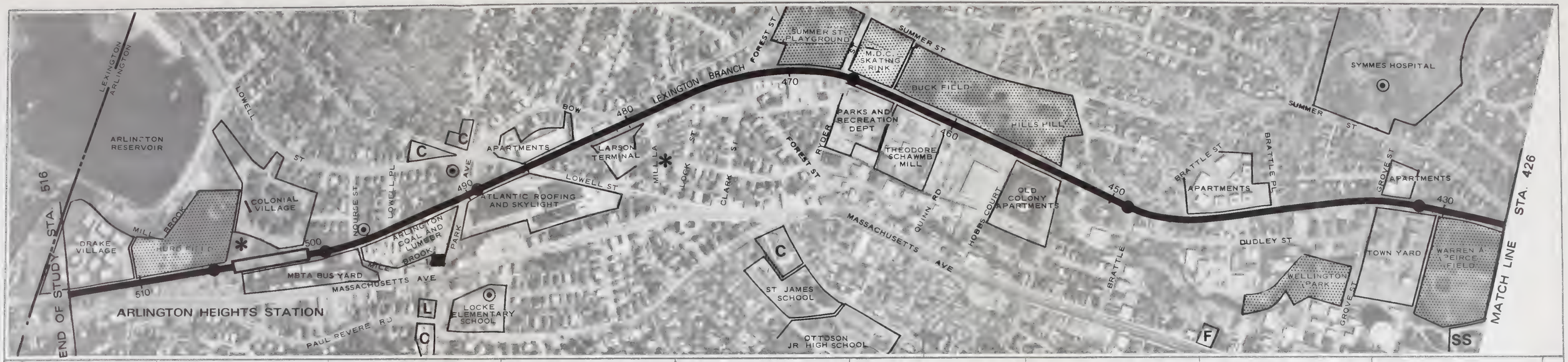
RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

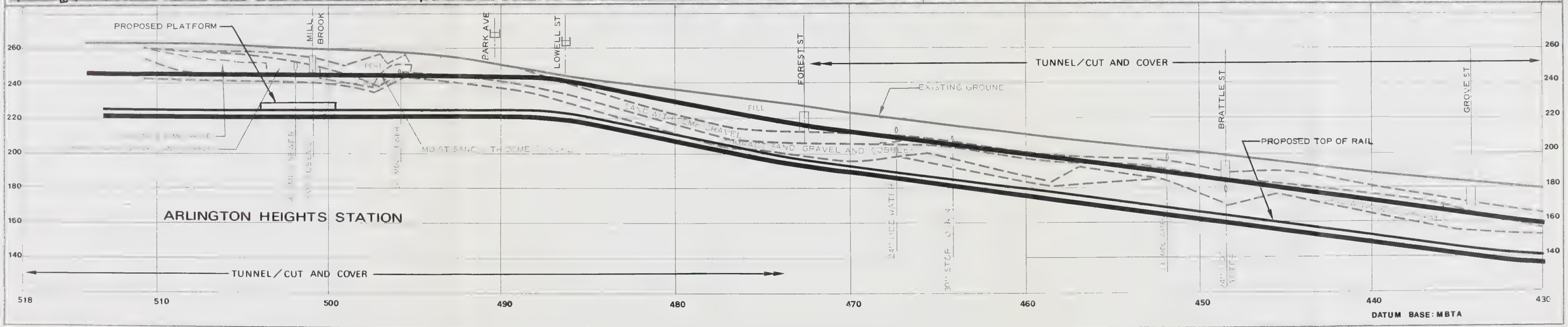
PROJECT ALIGNMENT

PROFILE AND
ENVIRONMENTAL RESOURCES

HORIZ 0 100 200 FEET 400 VERT 0 10 20 FEET 40

FIG. II-1D





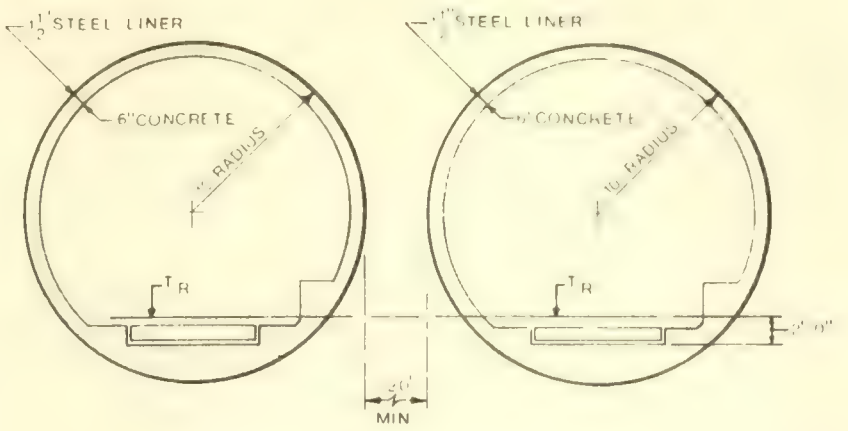
HORIZ 0 100 200 FEET 400
VERT 0 5 10 20 FEET 40

FIG. II-1E

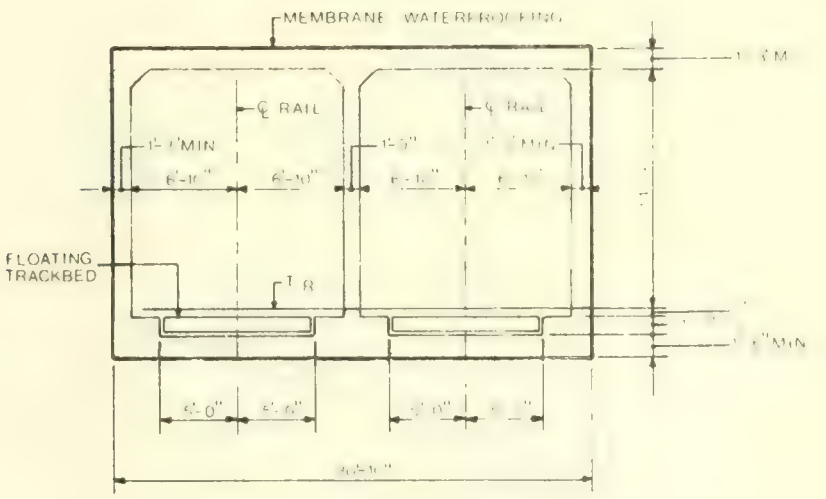
PROJECT ALIGNMENT

PROFILE AND
ENVIRONMENTAL RESOURCES

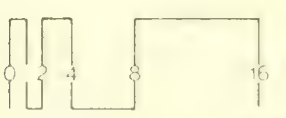
RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority



TUNNEL/DEEP BORE



TUNNEL/CUT AND COVER



Massachusetts Bay Transportation Authority

TYPICAL SECTIONS

FIG. II - 2

STA 505 ARLINGTON HEIGHTS

STA 400 ARLINGTON CENTER

STA 315 ALEWIFE

STA 265 DAVIS SQUARE

STA 230 PORTER SQUARE

STA 180 HARVARD SQUARE

1 PROJECT

MASS. AVENUE

TRANSFER COMMUTER RAIL TO RAPID TRANSIT

R.R. FITCHBURG MAINLINE (SAME FOR ALL ALTERNATIVES.

R.R. FREIGHT CUT OFF (AT GRADE)

TUNNEL/CUT & COVER

TUNNEL / CUT & COVER

TUNNEL / DEEP BORE

2 TUNNEL / CUT & COVER WITH RAILROAD

MASS. AVENUE

1 APPLICABLE TO 2 3 4 AND 5

R.R. BEDFORD DIVISION LEXINGTON BRANCH (AT GRADE)

R.R. FREIGHT CUT OFF (AT GRADE)

TUNNEL CUT & COVER

TUNNEL / CUT & COVER (R.R. LOADING)

3 AT GRADE

EITHER 1 OR 2 APPLICABLE TO 3 4 AND 5

AT GRADE

TUNNEL CUT & COVER

AT GRADE

TUNNEL CUT & COVER

4 LIGHT RAIL VEHICLE (LRV)

BRATTLE STREET

LAKE STREET

LRV TURNBACK

R.R.-BEDFORD DIVISION-LEXINGTON BRANCH (AT GRADE)

TRANSFER LRV TO RAPID TRANSIT

AT GRADE

TUNNEL CUT & COVER

AT GRADE

5 COMMUTER RAIL

R.R. BEDFORD DIVISION LEXINGTON BRANCH

AT GRADE

TUNNEL CUT & COVER

AT GRADE

R.R. FITCHBURG MAINLINE

LEGEND

STATION

PORTAL

RAILROAD

TRANSIT

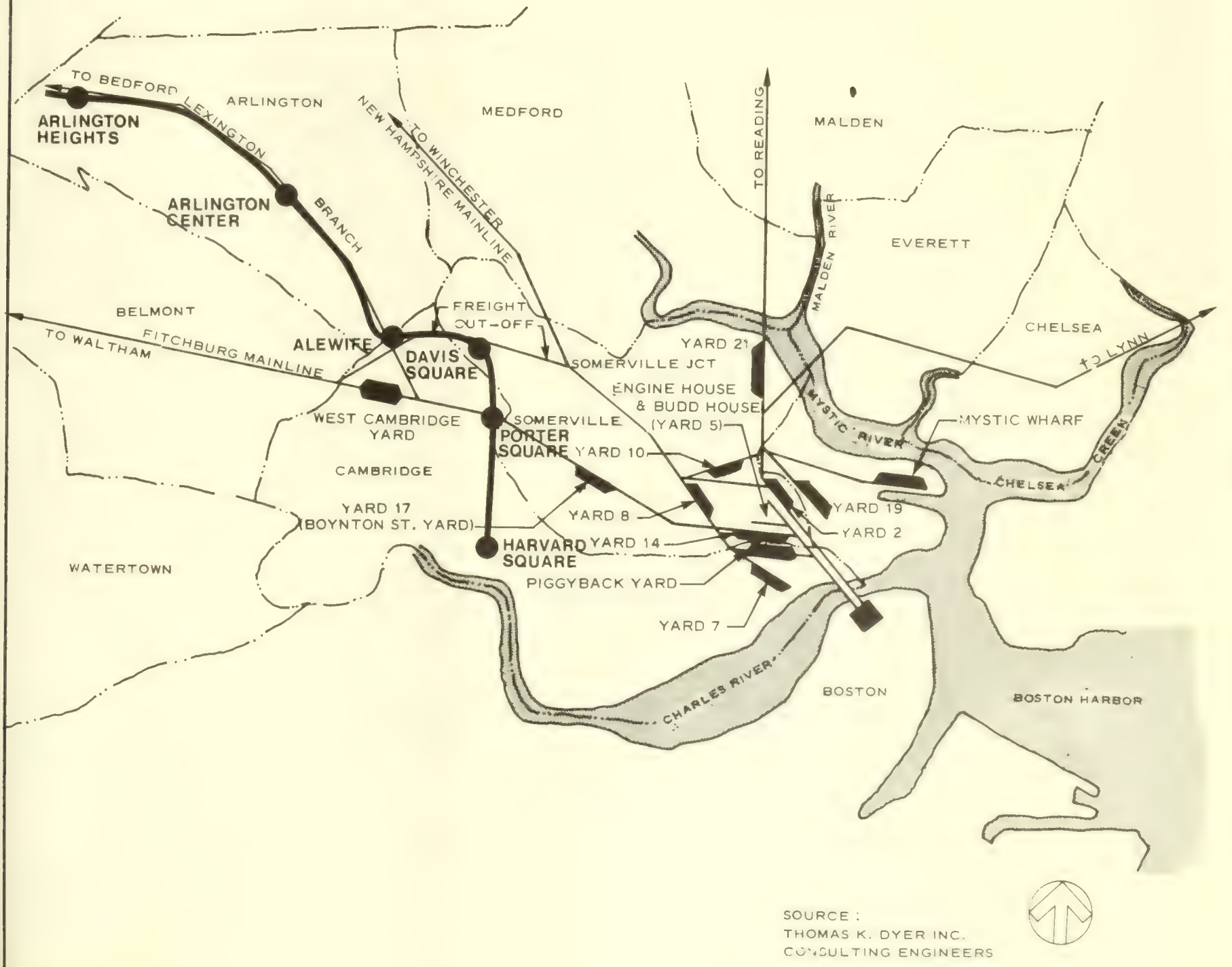
COMBINED FREIGHT AND COMMUTER/TRANSIT OPERATION

Massachusetts Bay Transportation Authority

ALTERNATIVE MODE

CONSTRUCTION METHODS BY LINE SEGMENT

FIG. II-3

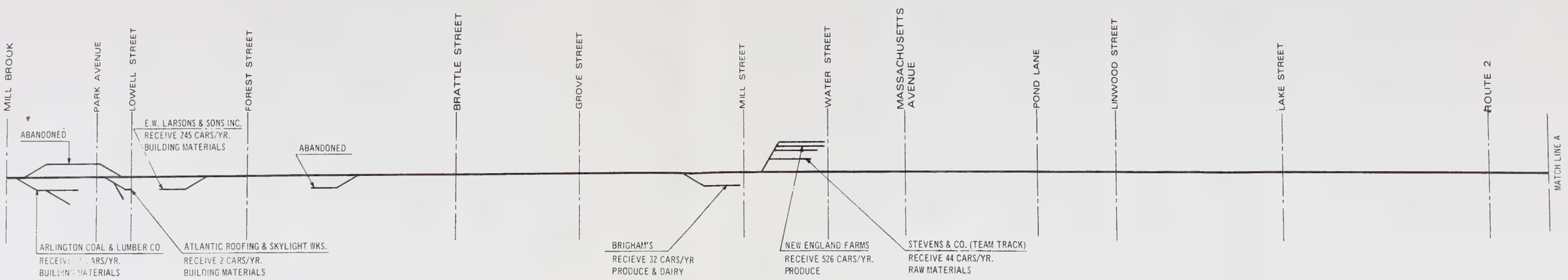


SOURCE :
THOMAS K. DYER INC.
CONSULTING ENGINEERS

RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

RAIL LINES
NORTHWEST SECTOR
FIG. II-4

BEDFORD DIVISION LEXINGTON BRANCH



TO LEXINGTON & BEDFORD

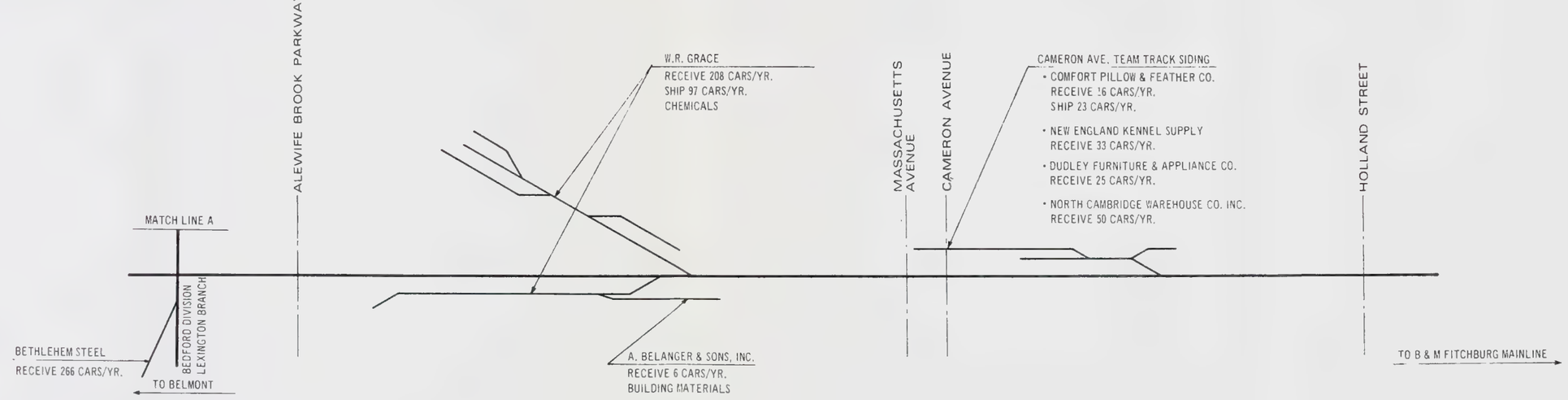
LEXINGTON, MASS.

- GOLD RIBBON FARMS
  RECEIVE 13 CARS/YR.
- LEXINGTON LUMBER
  RECEIVE 3 CARS/YR.
- SEASONS FOUR
  RECEIVE 4 CARS/YR.
- WILSON FARMS
  RECEIVE 1 CAR/YR.

BEDFORD, MASS.

- BELLINGHAM LUMBER
  RECEIVE 1 CAR/YR.
  SHIP 1 CAR/YR.
- GRIFFITH LADDER MFG.
  RECEIVE 15 CARS/YR.

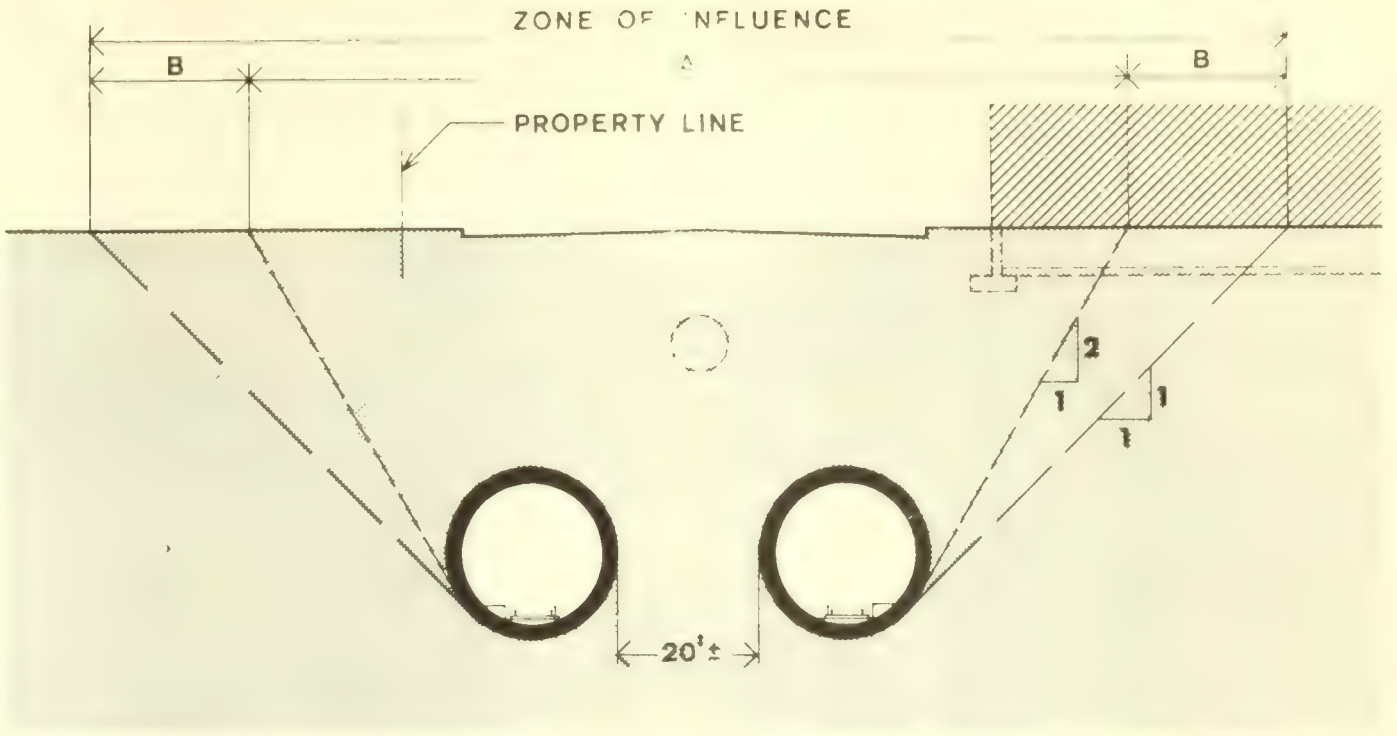
FREIGHT CUT-OFF



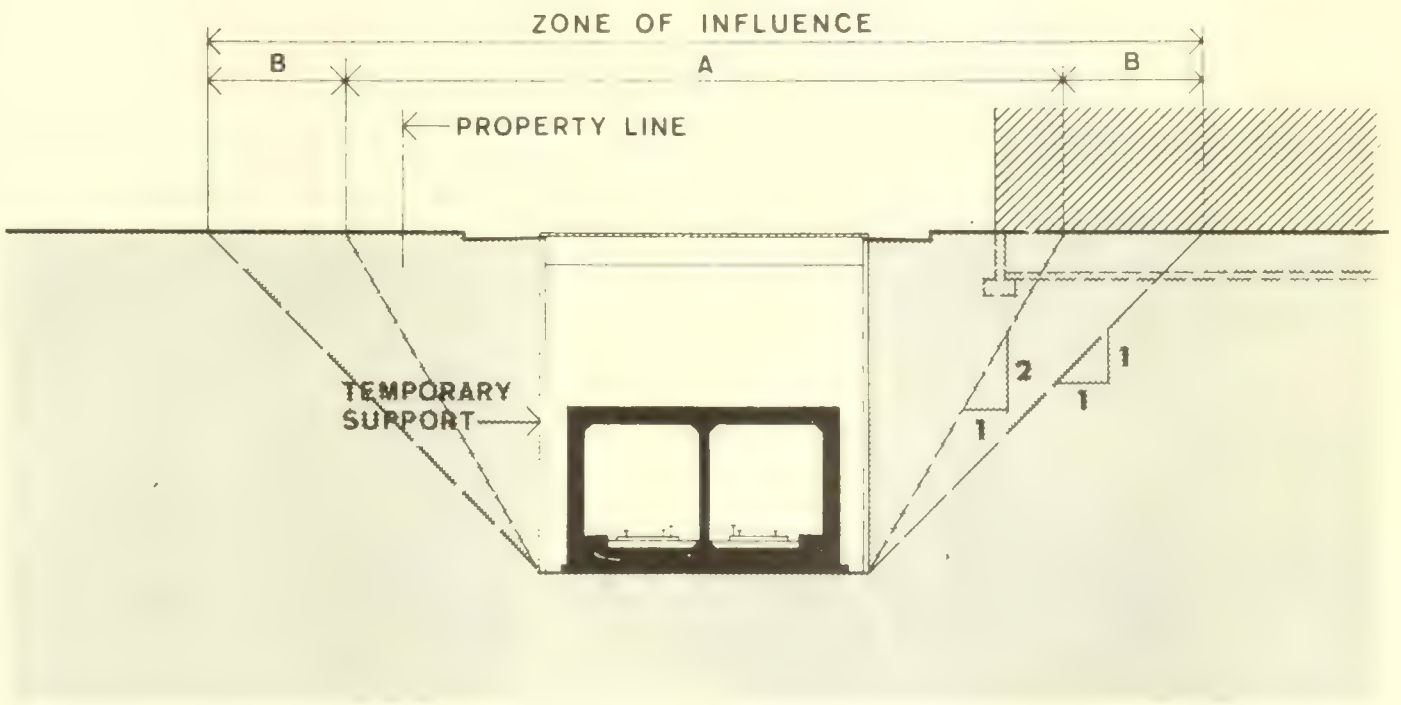
NOTE: FREIGHT CAR MOVEMENTS
ARE APPROXIMATE YEARLY AVERAGES.
SOURCES – BTPR REDBOOK,
BOSTON & MAINE RAILROAD & RECEIVERS

Massachusetts Bay Transportation Authority

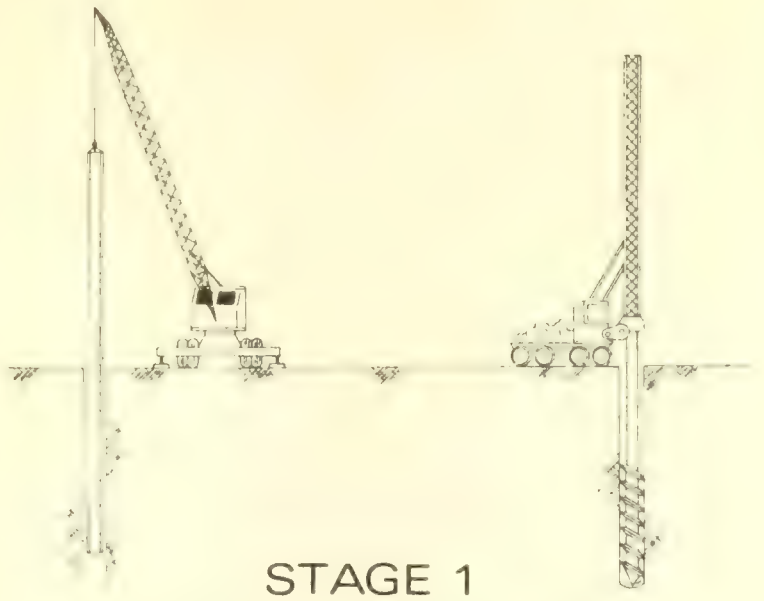
BOSTON AND MAINE
RAILROAD FREIGHT SERVICE
FIG. II-5



DEEP BORE

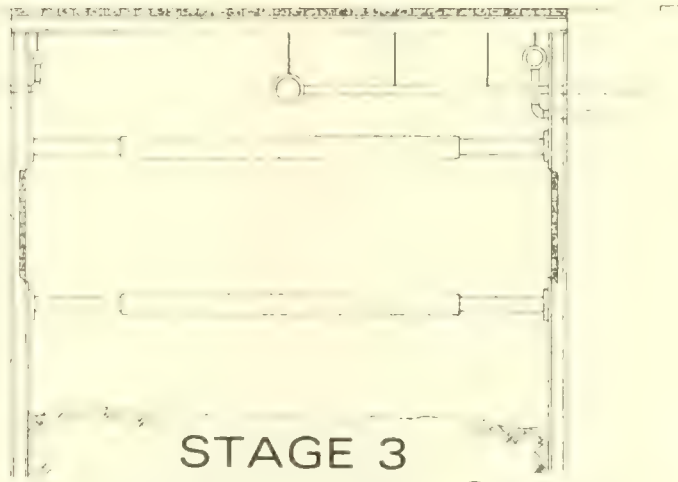


CUT and COVER



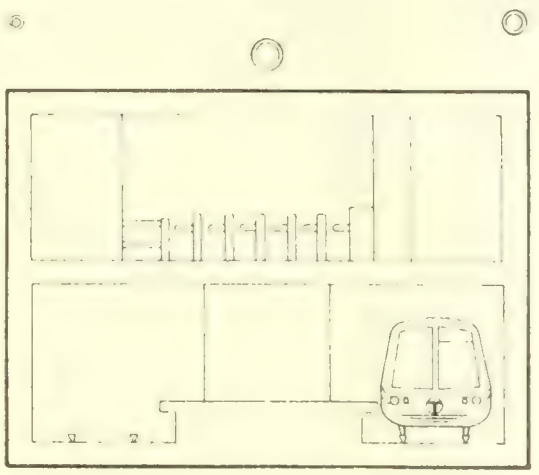
STAGE 1
SOLDIER PILE PLACEMENT

STAGE 2
INITIAL EXCAVATION
UTILITY HANGING



STAGE 3
PLACE LAGGING AND STRUTS
INSTALL STREET PLANKING
EXCAVATE TO TUNNEL INVERT

STAGE 4
POUR CONCRETE SLAB AND WALLS
REMOVE STRUTS

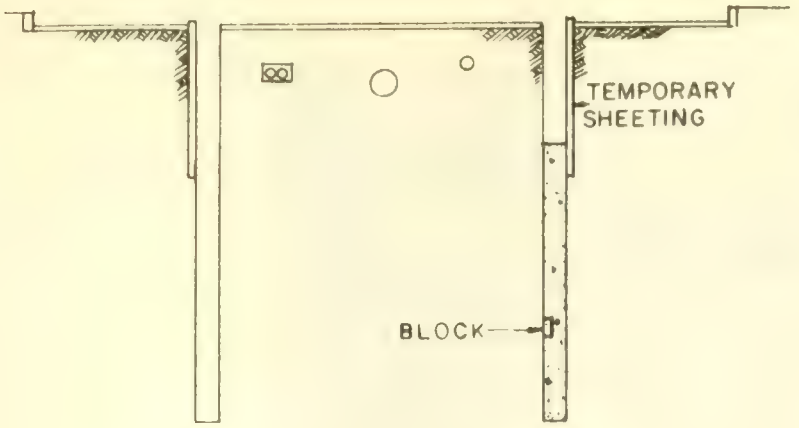


STAGE 5
WATERPROOF STRUCTURE
BACKFILL EXCAVATION
RECONSTRUCT STREET

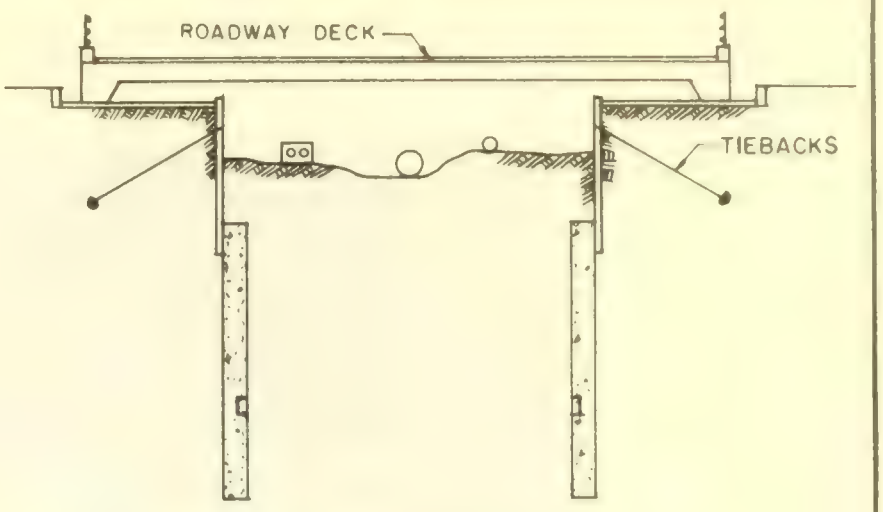
Massachusetts Bay Transportation Authority

CONVENTIONAL METHOD
CUT AND COVER CONSTRUCTION

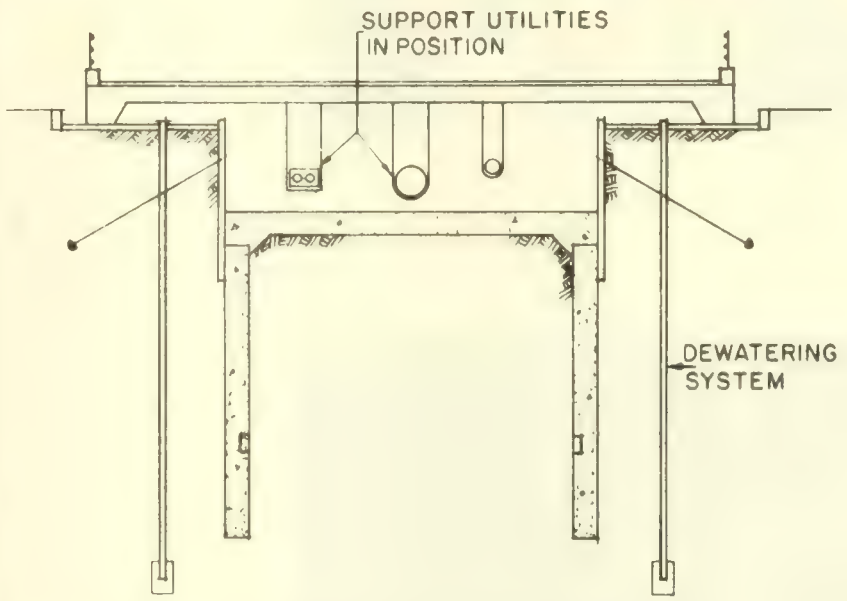
FIG. II - 7



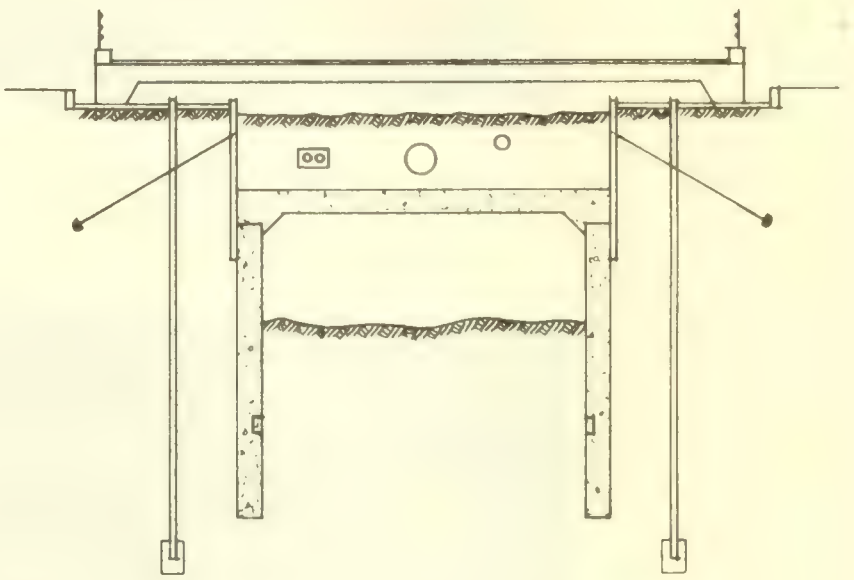
1 EXCAVATE WALL TRENCHES
PLACE CONCRETE SIDE WALLS



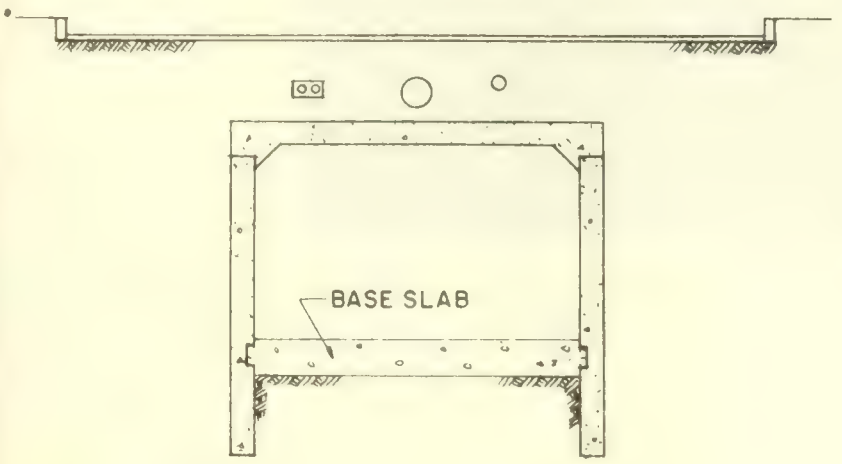
2 EXCAVATE TO DEPTH OF UTILITIES
PLACE DECK IN POSITION



3 EXCAVATE TO UNDERSIDE ROOF SLAB
PLACE CONCRETE ROOF SLAB



4 BACKFILL OVER ROOF SLAB
EXCAVATE UNDER ROOF SLAB

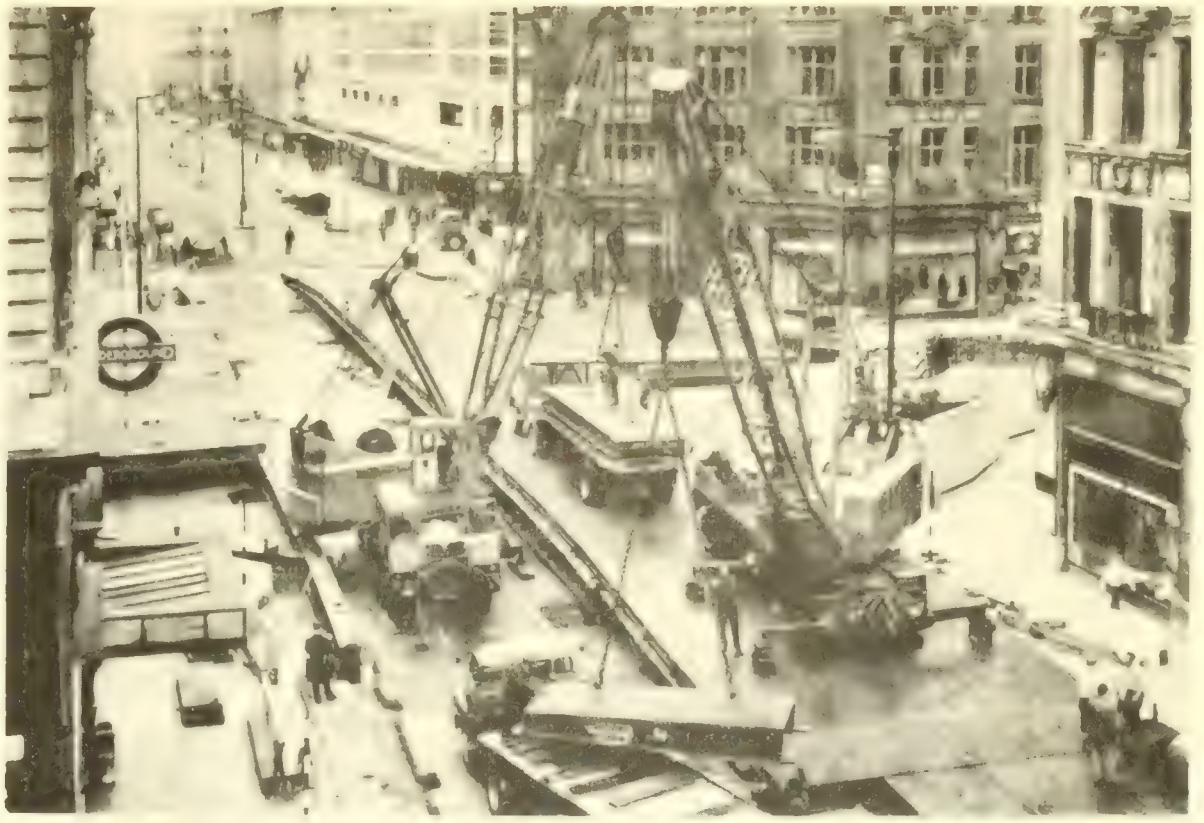


5 REMOVE DECK-COMPLETE RESTORATION
EXCAVATE TO UNDERSIDE BASE SLAB

CONSTRUCTION UNDER-THE-ROOF

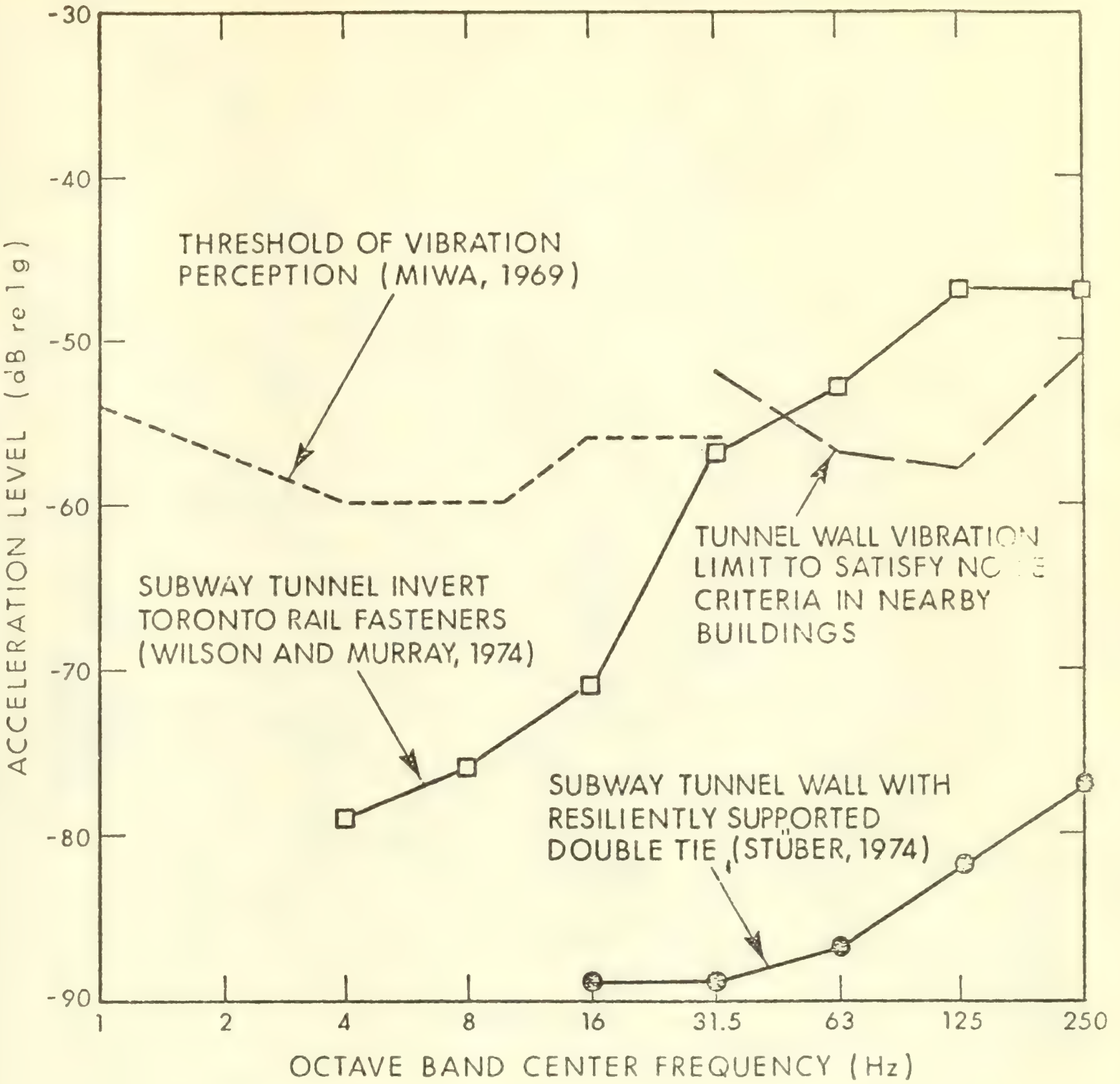
RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

MILAN METHOD
CUT AND COVER CONSTRUCTION
FIG. II - 8



SOURCE: JOHN R. DAY: THE STORY OF THE VICTORIA LINE;
LONDON TRANSPORT, 1970

UMBRELLA DECKING

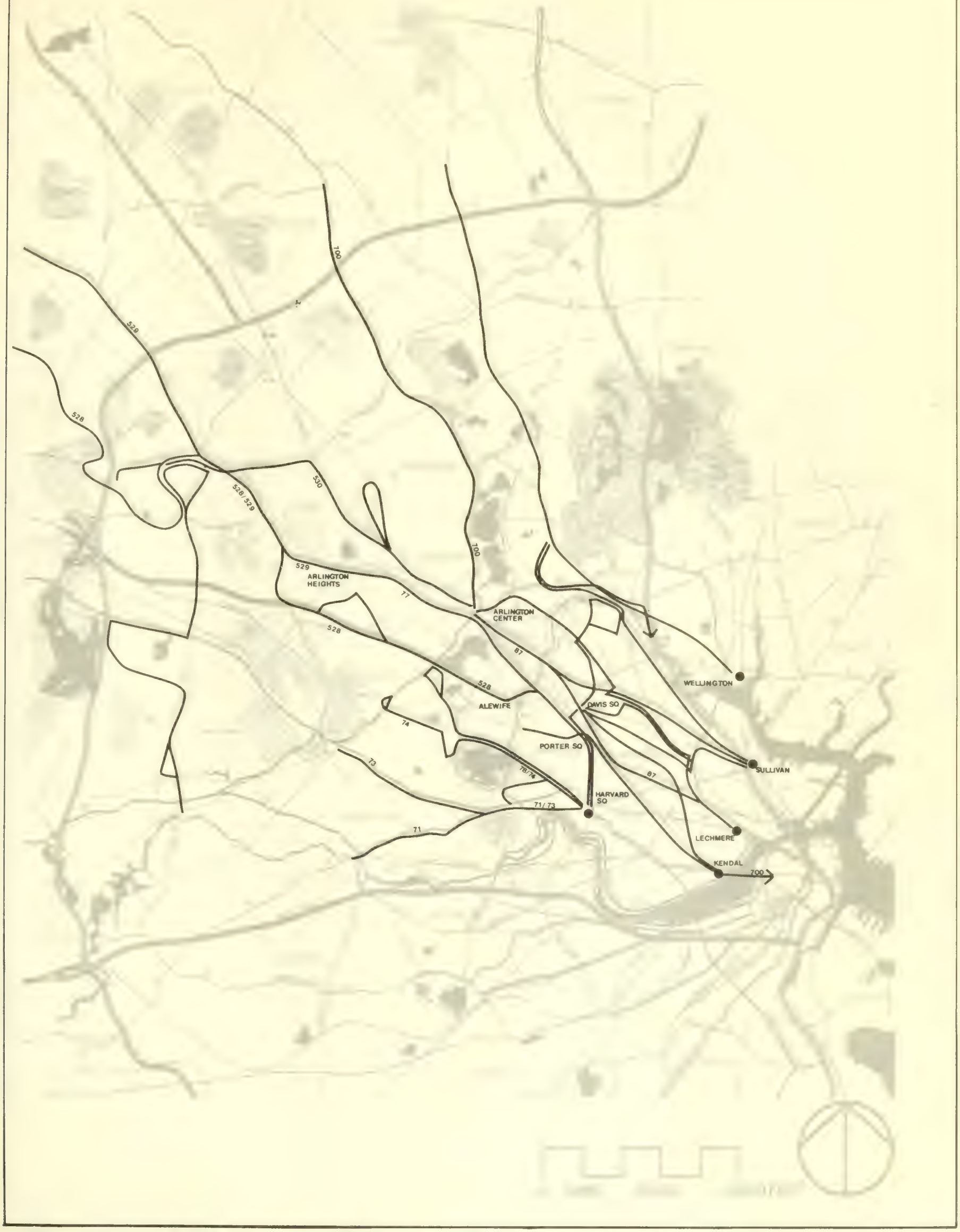


SUBWAY TUNNEL WALL AND INVERT VIBRATION LEVELS
IN RECENTLY-BUILT SYSTEMS

RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

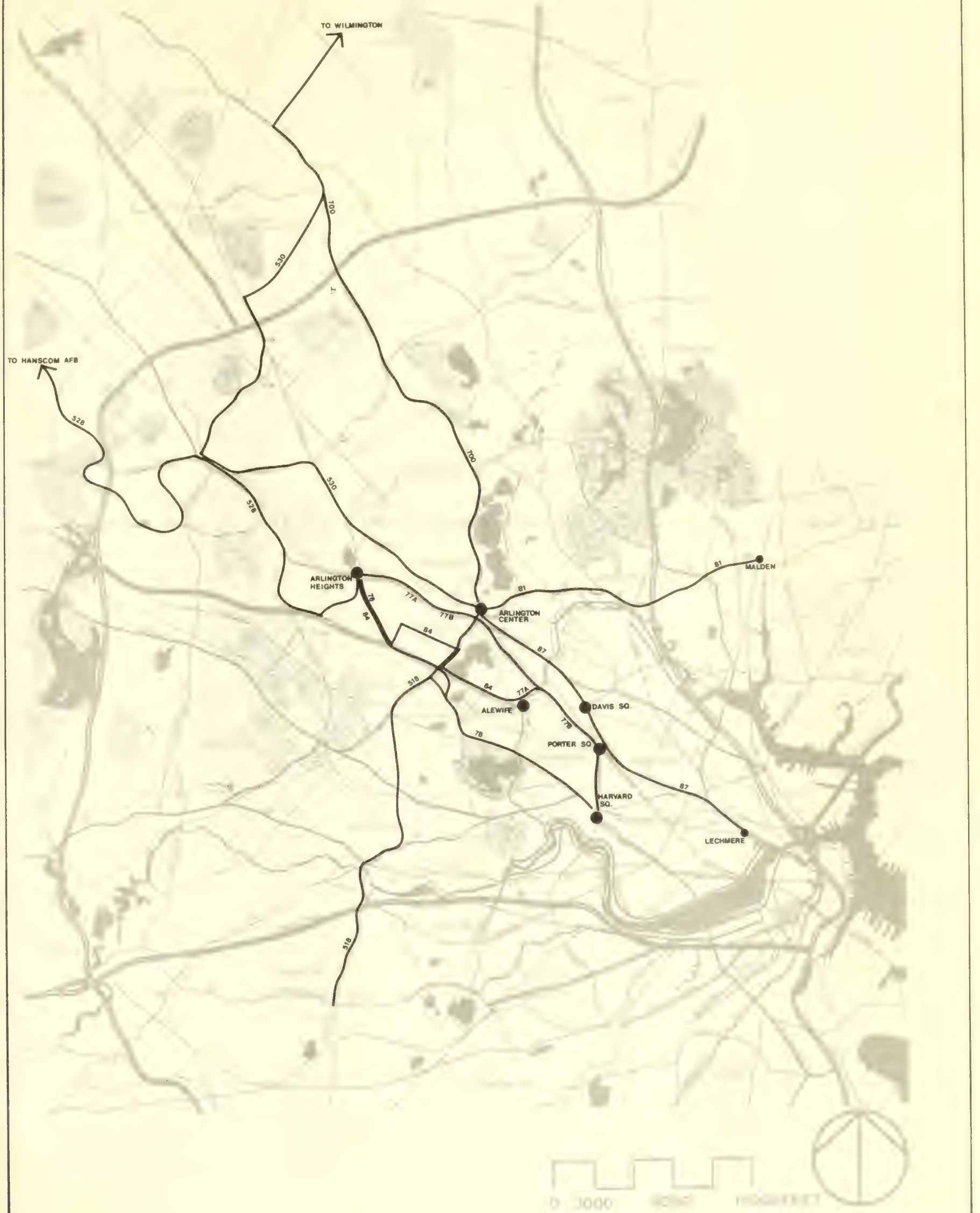
VIBRATION LEVELS

FIG. II – 10



RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

BUS ROUTES
EXISTING SYSTEM
FIG. II-11



RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

BUS ROUTES
PROPOSED SYSTEM
FIG. II-12

CITY OF CAMBRIDGE

CAMBRIDGE HISTORICAL COMMISSION

CITY HALL ANNEX, 57 INMAN STREET

CAMBRIDGE, MASSACHUSETTS 02139

Robert G. Neiley
Chairman

William B. King
Vice Chairman

Dwight H. Andrews
Arthur H. Brooks, Jr
James F. Clapp, Jr.
Charles W. Eliot, 2d

Hugh M. Lyons
Mrs. Charles M. Pierce
Joseph G. Sakey
Alternates

March 10, 1975

Mr. Dominic E. D'Eramo
Sverdrup & Parcel and Associates, Inc.
648 Beacon Street
Boston, Mass. 02115

Dear Mr. D'Eramo:

This is in answer to your request that the Historical Commission respond to the preliminary designation of five alternative routes for the extension of the Red Line subway.

Given the limited information presently available, the Commission can only rank the alternative according to their possible impact on architecturally and historically significant buildings. The criteria used have been, first, the possibility of direct adverse effect on structures and historic sites as a result of construction and operation, and, second, the indirect effects relating to the probable location of pedestrial entrances. We have also taken into account the relative importance of structures on the National Register of Historic Places, as well as those not on the Register but of local importance. Other factors not related to the effect of extension on structures of historical, architectural, or cultural importance have been disregarded.

Each of the proposed alternative routes has been evaluated in terms of the degree of damage that might be caused to significant structures on or eligible for the National Register of Historic Places. The routes have been ranked in decreasing order according to the potential for damage, as follows:

1. Alignment D-1. This route appears to have the highest potential for damage to structures of historic and architectural significance. The alignment runs along Harvard Yard for the entire length of Peabody Street, passing between Massachusetts and Harvard Halls, Holden Chapel, and

EXHIBIT A

several modern dormitories on one side and the First Church Unitarian-Universalist on the other. The entire Old Yard is on the National Register of Historic Places, and adverse effects on these structures must be minimized. The location of station entrances is not a significant problem in this area.

2. Alignment G-2. This route is also undesirable from the point of view of possible disruption of historic sites and structures. The tunnel passes directly beneath Christ Church, designed in 1760 by Peter Harrison, America's first trained architect, and associated with George Washington's presence in Cambridge during the Revolution; the possibility of damage to this structure must be minimized at all costs. The tunnel also passes beneath a portion of the Old Burying Ground, the only colonial cemetery in Cambridge and the burial place of numerous historical figures. The route along Mount Auburn Street and under Church Street also entails potential adverse effects on numerous structures of local significance, as outlined in our earlier assessment. The location of station entrances does not appear to be a problem.

3. Alignment G-1. This route passes directly by two properties on the National Register of Historic Places, which are also of greatest significance: the William Brattle House and the Dexter Pratt House, 42 and 54 Brattle Street, respectively. The possibility of structural damage from settlement or vibration in this area must be avoided. Furthermore, the placement of station entrances in Brattle Square is likely to result in a sharp increase in property values, making the maintenance of these relatively low-value structures problematical. The route also passes a relatively large number of structures of local significance.

4. Alignment A. This route causes no disruption of National Register structures except those in Radcliffe Yard. However, it does pass beneath an area of small nineteenth century residential structures along Hilliard Street and Hilliard Place, few of which are architecturally or historically important but which constitute a small neighborhood of fine scale and character. Negative effects on this area should be minimized. In other respects, this route causes little disruption.

5. Alignment D-2. This route passes between Massachusetts Hall and the First Church, Unitarian-Universalist, but then bears away from the Yard; disruption beyond this point seems minor.

The Historical Commission is convinced that construction of the Red Line Extension must proceed without delay. Once the final route has been chosen, we will be most willing to work with you and the MBTA to further minimize the negative effects of construction.

If we can be of any further assistance, please feel free to call me or our Executive Director, Charles Sullivan.

Yours,

Robert G. Neiley

Robert G. Neiley
Chairman

RGN/dl

CC: Elizabeth Amadon,
Massachusetts Historical Commission

James L. Sullivan, City Manager

MEMORANDUM

The De Leuw, Cather Organization

To: J. W. Mullaney - Boston
Office: J. L. Angell - Boston
D. D'Eramo - S&P

From: N. J. Pointner II
Office: Chicago

Date: January 19, 1976

Ref. or
Job No. 2543-00

Subject: Meeting on Wendesday, January 14 1976 at the Massachusetts Historical Commission

In Attendance:

Elizabeth R. Amadon - Massachusetts Historical Commission
Charles M. Sullivan - Cambridge Historical Commission
George Wey - MBTA
Donald J. Kidston - MBTA
Kiyoshi Mano - DOT/UMTA, Washington, D.C.
Joseph Clougherty - DOT/UMTA, Region I
Jerrell L. Angell - De Leuw, Cather & Company
Norbert J. Pointner II - De Leuw, Cather & Company
D. D'Eramo - Sverdrup & Parcel
A. D. Rudolph - Sverdrup & Parcel

The purpose of the meeting was to review the status of the Red Line Extension Project and the possible impact on historic resources. Particular emphasis was placed upon discussion of Section 106 procedures as they pertain to the Harvard Square area.

Prior to the meeting, Dom D'Eramo of Sverdrup & Parcel had distributed a 12-page draft of information which could serve as a basis for a case report on potentially affected National Register properties in the Harvard Square area. Detailed drawings at 1" = 20' and 1" = 40' were brought to the meeting for this critical area. Aerial photographs at 1" = 400' showing alignment and station locations for the project beyond Harvard Square were also displayed.

The following information was presented concerning historic resources beyond Harvard Square:

A. A bored tunnel would pass in the vicinity of the North Avenue Congregational Church at 1803 Massachusetts Avenue. It is of primary importance on the Cambridge rating system and is expected to be a National Register nominee. It is an 1845 structure by Isaac Melvin of Eyptian-Greek revival character. The structure is located adjacent to the furthestmost extremity of the potential zone of influence from the tunnel which is more than 70 feet beneath the surface. It is not expected that the tunnel will have any influence at all on this structure, but it is mentioned because it is the most significant historic resource along the zone of influence of the transit alignment.

EXHIBIT B

B. There would be some slight, temporary disruption during construction of the Hobbs Building and the Somerville Theater described on page VIII-33 in the review copy of the Draft Environmental Impact Analysis Report.

C. There are no historic resources in the Alewife area and all of the land which will be disturbed through construction of the facility has been previously disrupted by contemporary urban development and dumping activities.

D. In 1967 a .02 acre site, bisected by the B&M Railroad line and surrounded by automobile traffic, was dedicated as Whittemore Historic Park and a statue was erected to commemorate the hero of a Revolutionary War battle which occurred in vicinity. Working through Alan McClennen,Jr., Director of Planning and Community Development for the Town of Arlington, a plan has been devised so that cut-and-cover construction of a transit station in Arlington Center would result in the relocation of the monument and the designated site to a more favorable location, accessible to pedestrians and without the influence encircling traffic. The park is located at the intersection of Massachusetts Avenue and Mystic Streets and would be moved to a location south of Mystic Street and east of Massachusetts Avenue.

E. Railroad abutments at the Brattle Street crossing of the alignment between Arlington Center and Arlington Heights would be displaced by construction of the Red Line along the B&M Railroad right-of-way. These abutments are classified as "of only local interest as examples of fairly common early architectural styles". By following the railroad alignment, virtually all of the more significant examples of historic resources in the corridor have been avoided.

Dom D'Eramo and Allen Rudolph then described in detail the anticipated effects on National Register properties in the Harvard Square area. Although there is no long-term projected impact on National Register properties, short-term impact would occur during construction. Mrs. Amadon agreed that the selected alternative was the least disruptive of those considered to historic resources. In response to questions posed by Mrs. Amadon, the following points were made:

A. The duration of the construction process is an important factor when evaluating the potential impact. Dom suggested that total construction would take approximately 28 months. It was pointed out, however, that restoration of the fence, landscaping and other elements of Flagstaff Park could begin well before the completion of the station complex. An estimate of this amount of time will be forthcoming from Dom D'Eramo.

B. The specific response necessary to comply with procedures set up by Section 106 of the National Historic Preservation Act need to be determined by Mrs. Amadon in her role as State Preservation Officer and Mr. Kiyoshi Mano as representative of the sponsoring Federal agency, the Urban Mass Transportation Administration of the U. S. Department of Transportation. The Draft Environmental Impact Statement cannot be considered complete until the requirements of Section 106 have been complied with. This Draft EIS is also a necessary prerequisite to a final EIS and subsequent Capital Grant for a project. Compliance with the requirements of Section 106 could take place in two ways, yet to be determined by Mrs. Amadon and Mr. Mano. These two courses of action are generally described as follows:

- A case report, in this case building upon Dom D'Eramo's information previously referenced, would be prepared by the MBTA (or their consultants) and submitted to Mrs. Amadon. Under her direction and in close coordination with Mr. Mano, a "sign-off" judgment could be given by Mrs. Amadon and Mr. Mano and a letter sent to the Adivsory Council on Historic Preservation stating that no impact, as determined by the "criteria of effect" would occur to National Register properties. The Advisory Council, upon review of the supporting case report, could then concur and the project could proceed. The sign-off would be provisional based upon certain safeguards and provisos agreed to by the MBTA. These provisos might include, for instance, review procedures whereby the state and local historical commissions could monitor and participate in the supervision of protective, mitigating and restorative measures agreed to by the MBTA.

- A second course of action would be very similar. It would begin with a finding of the Massachusetts Historical Commission that there were significant effects as determined by the criteria of effect. This finding would also be supported by a case report and submitted to the Advisory Council on Historic Preservation. In this case, however, a detailed and lengthy staff investigation would be conducted. The detailed program for protection, mitigation and restoration would then require approval of the Advisory Council. A memorandum of agreement would then be prepared between the Department of Transportation and the Advisory Council on Historic Preservation with the concurrence of the Massachusetts Historical Commission.

C. A number of specific suggestions were made. Although a sign-off letter had been obtained from Mr. Robins, the State Archaeologist, recent State laws in Massachusetts and reviewers in the Department of the Interior, warrant additional verification of the lack of archaeological resources that might be affected by the project. Mrs. Amadon praised Mr. Robin's knowledge of prehistoric archaeology but suggested that some additional verification be received from someone knowledgeable concerning the potential for historical archaeological artifacts in the Harvard Square station area. Mr. Sullivan suggested that the city's records of prior development in that vicinity were sufficiently accurate so that the Historical Commission could verify the absence of historical artifacts in the area which would be affected by construction of the subway station.

D. Mrs. Amadon emphasized the importance of representation by the Cambridge Historical Commission on the committee working with MBTA in the Harvard Square area. She cautioned that an early warning system was needed to alert the city and state historical commissions to each step in the continuing design activities in Harvard Square. Too frequently, architects and engineers invest thousands of dollars in man-hours in developing designs which do not properly consider historic resources. Protective and restorative measures are, therefore, extremely costly, and are undertaken by the sponsoring agency only with a great deal of reluctance. If the state and city historical commissions are involved in the design from the earliest phases on, most of the wasteful exercises can be avoided.

E. Mrs. Amadon noted that if a station entrance or other design feature of a station or alignment affects the setting of a structure or district on the National Register, the State Historical Commission must be consulted just as if the undertaking were, in fact, directly affecting the structure, site or district. In this instance, the entrance to the current subway station, which is integral with the fence in Flagstaff Park and the proposed entrances to the Arlington Center stations, which abut the National Register property on the northwest corner of the intersection of Mystic and Massachusetts Avenue, are two specific examples.

F. Mr. Sullivan is revising a draft of a letter which will be delivered to the MBTA, noting the concurrence of Mrs. Amadon, summarizing the reactions of the Cambridge Historical Commission to the Red Line Project. Though there is strong support for the project, and a recognition that the selected alternative is the least disruptive to

historic resources, it identifies several critical areas requiring further attention. The first of these is the protection of the kiosk in Harvard Square. A sketch prepared by the architect, Marcel Breuer as a subconsultant to Sverdrup & Parcel, who are consultants to the MBTA, shows existing kiosk totally replaced by a new station entrance. Although the kiosk was not listed in the letter sent to the MBTA consultants by the Cambridge Historical Commission as being an historic resource of the Harvard Square area, both Mrs. Amadon and Mr. Sullivan stressed the importance of keeping this symbolic and historic landmark. It was further stated that it would be most desirable if it could remain as the head for an entrance to the new Harvard Square station. The kiosk could come under the protection of at least Section 4(f) and, therefore, it would be necessary for the MBTA to demonstrate quite clearly that there was no prudent and feasible alternative to the relocation or destruction of the kiosk.

G. Mrs. Amadon expressed appreciation at the opportunity for the meeting, and was generally in concurrence with the conclusions of the MBTA studies. She cautioned, however, that this in no way was a sign-off by the State Historical Commission under Section 106 procedures. The next step is for Mr. Mano and Mrs. Amadon to prepare a joint recommendation for compliance with Section 106. Mr. Pointner and Mr. D'Eramo will prepare a draft copy of the minutes of the meeting and the MBTA will provide some additional detail for the case report. Mr. Sullivan will verify the lack of historical, archaeological potential and send Mr. D'Eramo a copy of his letter for inclusion in the environmental analysis report.

NJP:lk

PAUL GUZZI
Secretary of the
Commonwealth

The Commonwealth of Massachusetts
Office of the Secretary
Massachusetts Historical Commission
294 Washington Street Boston, Massachusetts 02108
(617) 727-8470

January 16, 1976

Mr. Domenic E. D'Eramo, P.E.
Sverdrup & Parcel and Associates
648 Beacon Street
Boston, Massachusetts 02215

Re: MBTA Red line extension from Cambridge to Arlington

Dear Mr. D'Eramo:

I am writing in response to your request for comments on our meeting which took place on January 14, 1976 and included representatives of Sverdrup and Parcel, the Massachusetts Bay Transportation Authority, the Urban Mass Transportation Administration, the Cambridge Historical Commission and myself as State Historic Preservation Officer and director of the Massachusetts Historical Commission. This meeting involved the review of the preferred alternative, D-2, for the above project.

I agree that of all the alternatives presented in the draft 106 Review, dated January 6, 1976, Alternative D-2 has the least adverse effect on historic properties. The only alternative which would cause no effect is "no build", an unacceptable choice as the need for the Red Line extension and improvements has been adequately demonstrated.

These comments apply only to the proposed plans and specifications as presented to us on January 14 and to designated Alternative D-2. If alterations are made in this alternative and as it is further developed, additional review will be necessary.

I would like to make the following requests and recommendations:
Cambridge
1) At Harvard Square, the reconstruction of the wall bordering Harvard Yard (in the National Register Historic District) should take place at the earliest possible time in the construction period.

EXHIBIT C

2) The retention and reuse of the 1928 Subway kiosk, located at the junction of Massachusetts Avenue, Brattle and Dunster Streets in the center of the street, should be studied in depth. Any new construction located here is also subject to review for compatibility with the contiguous National Register historic district. I would like to request an opportunity for my review of this area of concern at the earliest study and design stage.

3) An engineering study should be made and all means taken to insure protection of the foundation and walls of the First Parish Unitarian Church (on the National Register).

4) In cooperation with the Cambridge Historical Commission and the Cambridge Conservation Commission, plans should be made for the type and location of any new trees to replace those which must be removed during construction in Flagstaff Park. Also, the location and design of the vent should be planned to meet the approval of the aforementioned commissions and myself.

5) The design of any street furniture and type and location of any trees removed during construction in the entire Harvard Square/Cambridge Common Historic Districts is subject to review by this office.

I recognize that there will be a short term adverse effect on the National Register districts during construction which cannot be mitigated but I also feel there is no prudent and feasible alternative to this effect. With proper review, the possible long term adverse effects can be removed or mitigated.

Arlington

1) The design of the proposed above ground subway station, located at the junction of Massachusetts Avenue, Pleasant and Mystic Streets, is subject to review for compatibility with the contiguous Arlington Town Center National Register Historic District. The Arlington Historical Commission and this office should be consulted at the earliest design stage.

2) The relocation of the commemorative plaque, now at the above junction, will not require my review, providing the Arlington Historical Commission is satisfied with the new location.

The above comments represent the consensus of agreement reached at the January 14 meeting. I recognize and commend the study which has gone into

this project and appreciate the willing cooperation extended to the review agencies by everyone involved in the planning.

Sincerely yours,

Elizabeth Reed Amadon

Elizabeth Reed Amadon
Executive Director
Massachusetts Historical Commission
State Historic Preservation Officer

ERA/mw

xc: John McDermott, Advisory Council
Robert Neiley, Cambridge Historical Commission
Charles Sullivan, Cambridge Historical Commission
Ki Mano, Urban Mass Transportation Administration
George Wey, Massachusetts Bay Transportation Authority

CITY OF CAMBRIDGE

CAMBRIDGE HISTORICAL COMMISSION

CITY HALL ANNEX, 57 INMAN STREET

CAMBRIDGE, MASSACHUSETTS 02139

Robert G. Neiley
Chairman

William B. King
Vice Chairman

Dwight H. Andrews
Arthur H. Brooks, Jr.
James F. Clapp, Jr.
Charles W. Eliot, 2d

Hugh M. Lyons
Mrs. Charles M. Pierce
Joseph G. Sakey
Alternates

January 30, 1976

Domenic E. D'Eramo, P. E.
Sverdrup & Parcel and Associates
648 Beacon Street
Boston, Mass. 02215

Dear Mr. D'Eramo:

I am writing, as agreed at our meeting on January 14, to review the draft "Determination of Effect on National Register Properties" of the proposed extension of the MBTA's Red Line through Harvard Square and under Massachusetts Avenue to the Somerville line. The following is a result of consultation with Elizabeth Amadon, the State Historic Preservation Officer, and represents the Commission's position with regard to the plans as they have been formulated to date.

The Draft correctly states that the entire Cambridge Common and Old Harvard Yard Districts are on the National Register. As we pointed out at the meeting, all structures and features within or surrounding a National Register District must be given equal consideration to minimize adverse effects, and all new construction similarly falls within the 106 review process. We do not feel that the temporary adverse effects to be encountered during the construction phase are grounds for extensive revision of the project, although we expect that evidence will be provided to demonstrate that these effects have been minimized.

The demolition of the present Harvard Square kiosk and the construction of such features as new headhouses, bus ramps, and ventilating shafts are specific matters of concern. The State Historic Preservation Officer and I substantially agree that the kiosk cannot be removed if a feasible and prudent alternative to its destruction exists, although this does not mean that it must continue to be used for a station entrance. The statement in the Draft that the adverse effect of "Destruction or alteration of all or part of a property" will only be a factor during the construction period is incorrect.

EXHIBIT D

I have investigated the possibility that significant archeological remains may lie in the path of the extension. It is my opinion that such remains will not be found, as almost the entire area to be disturbed for the excavation has either been a public way since the settlement of Cambridge or was dug up for the construction of the original subway. However, I expect that reasonable care will be taken in the event that unexpected remains are found.

As a procedural matter, I would like to point out that the Advisory Council procedures for review of the plans must be outlined in the draft E.I.S. These procedures, as well as the remaining steps in the review process with the Cambridge Historical Commission, the Massachusetts Historical Commission, and other public and private bodies has not, to my knowledge, been clearly outlined. In my opinion, the whole review process would be greatly facilitated if the steps that will be taken in this regard can be set out in detail.

I hope that these comments will be useful; please let me know if I can be of any further assistance.

Yours,

Charles M. Sullivan
Executive Director

CMS/dl

CC: Elizabeth Amadon,
Massachusetts Historical Commission
Kiyoshi Mano,
Urban Mass Transportation Administration

4F SITES IN HARVARD SQUARE AREA

LEGEND :

- CAMBRIDGE COMMON HISTORIC DISTRICT
- OLD HARVARD YARD HISTORIC DISTRICT

NR---- NATIONAL REGISTER DISTRICT
CHC -- CAMBRIDGE HISTORIC DISTRICT
NHL -- NATIONAL HISTORIC LANDMARK
NRS -- NATIONAL REGISTER SITE

HISTORIC SITES:

1	WADSWORTH HOUSE	NR
2	LEHMAN HALL	NR
3	STRAUS HALL	NR
4	MASSACHUSETTS HALL	NR,NHL,CHC
5	HARVARD HALL	NR,CHC
6	LIONEL HALL	NR
7	GANNET HOUSE	NR,CHC
8	HASTING HALL	NR,CHC
9	HARVARD-EPWORTH CHURCH	NR,CHC
10	FIRST PARISH CHURCH UNITARIAN	NR, CHC
11	CHRIST CHURCH	NR,NHL,CHC
12	1 GARDEN ST.	NR,CHC
13	FAY HOUSE	NR,CHC
14	LONGFELLOW HALL	
15	77 BRATTLE STREET	
16	42 BRATTLE STREET	NRS
17	54 BRATTLE STREET	NRS
18	76 BRATTLE STREET (GREENLEAF HOUSE)	

CAMBRIDGE COMMON

OLD BURYING GROUND

PARK RECREATIONAL SITES:

CAMBRIDGE COMMON

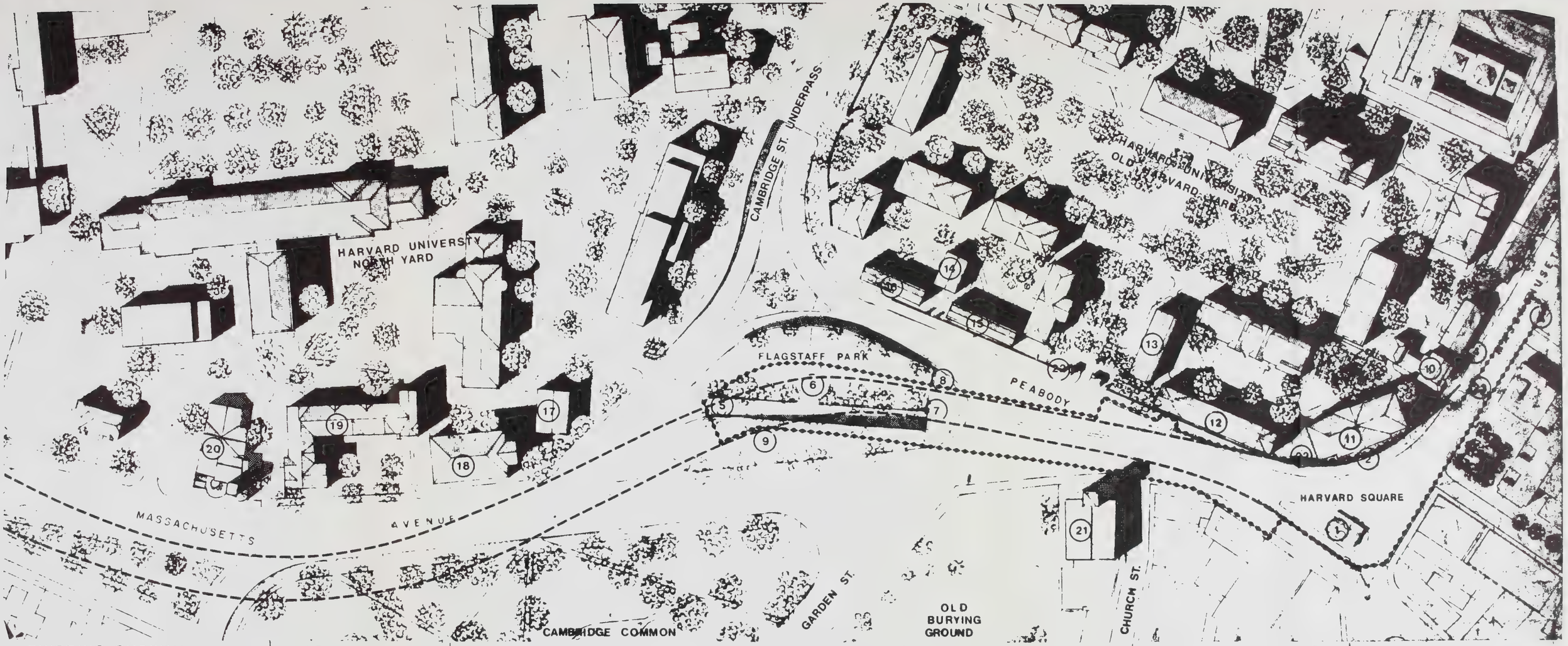
FLAGSTAFF PARK

NORTH LITTLE COMMON

Massachusetts Bay Transportation Authority

HARVARD SQUARE
EXISTING CONDITIONS

EXHIBIT E



EXISTING SUBWAY

1 KIOSK
2 ENTRANCE AT LEHMAN HALL
3 ENTRANCE AT HOLYOKE CENTER
4 EXIT NEAR WADSWORTH HOUSE
5 BUS INCLINE

FLAGSTAFF PARK

6 FLAGPOLE
7 STATUE
8 TERRACE
9 PARKING

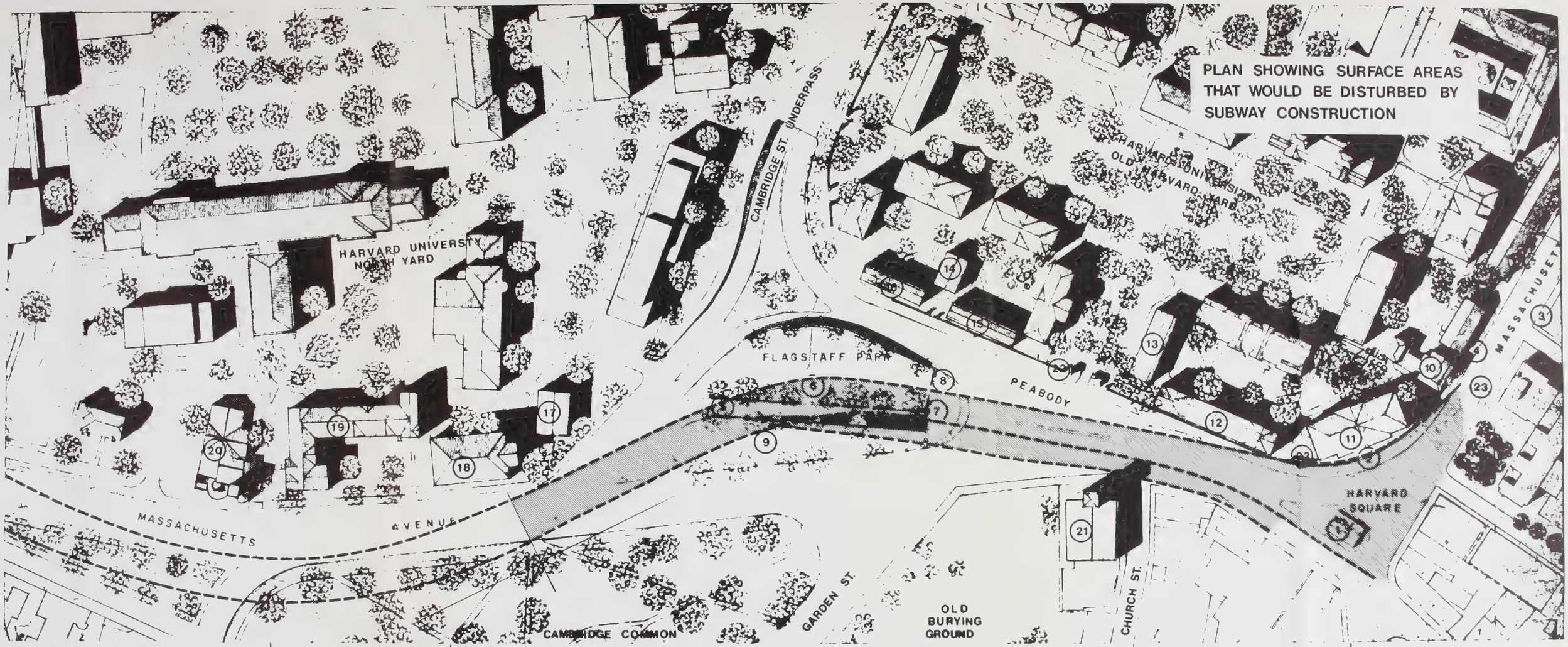
BUILDINGS IN N.R. DISTRICTS NEAR PROPOSED UNDERTAKING

10 WADSWORTH HOUSE
11 LEHMAN HALL
12 STRAUS HALL
13 MASSACHUSETTS HALL
14 HOLDEN CHAPEL
15 LIONEL HALL
16 MOWER HALL
17 GANNETT HOUSE
18 HEMENWAY GYM
19 HASTING HALL
20 HARVARD-EPWORTH METHODIST CHURCH
21 FIRST CHURCH UNITARIAN

MISCELLANEOUS

22 MEMORIAL FENCE
23 BRASS PLATES
LIMIT OF CONSTRUCTION

EXHIBIT F



EXISTING SUBWAY

1 KIOSK
2 ENTRANCE AT LEHMAN HALL
3 ENTRANCE AT HOLYOKE CENTER
4 EXIT NEAR WADSWORTH HOUSE
5 BUS INCLINE

FLAGSTAFF PARK

6 FLAGPOLE
7 STATUE
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BUILDINGS IN N.R. DISTRICTS NEAR PROPOSED UNDERTAKING

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15 LIONEL HALL
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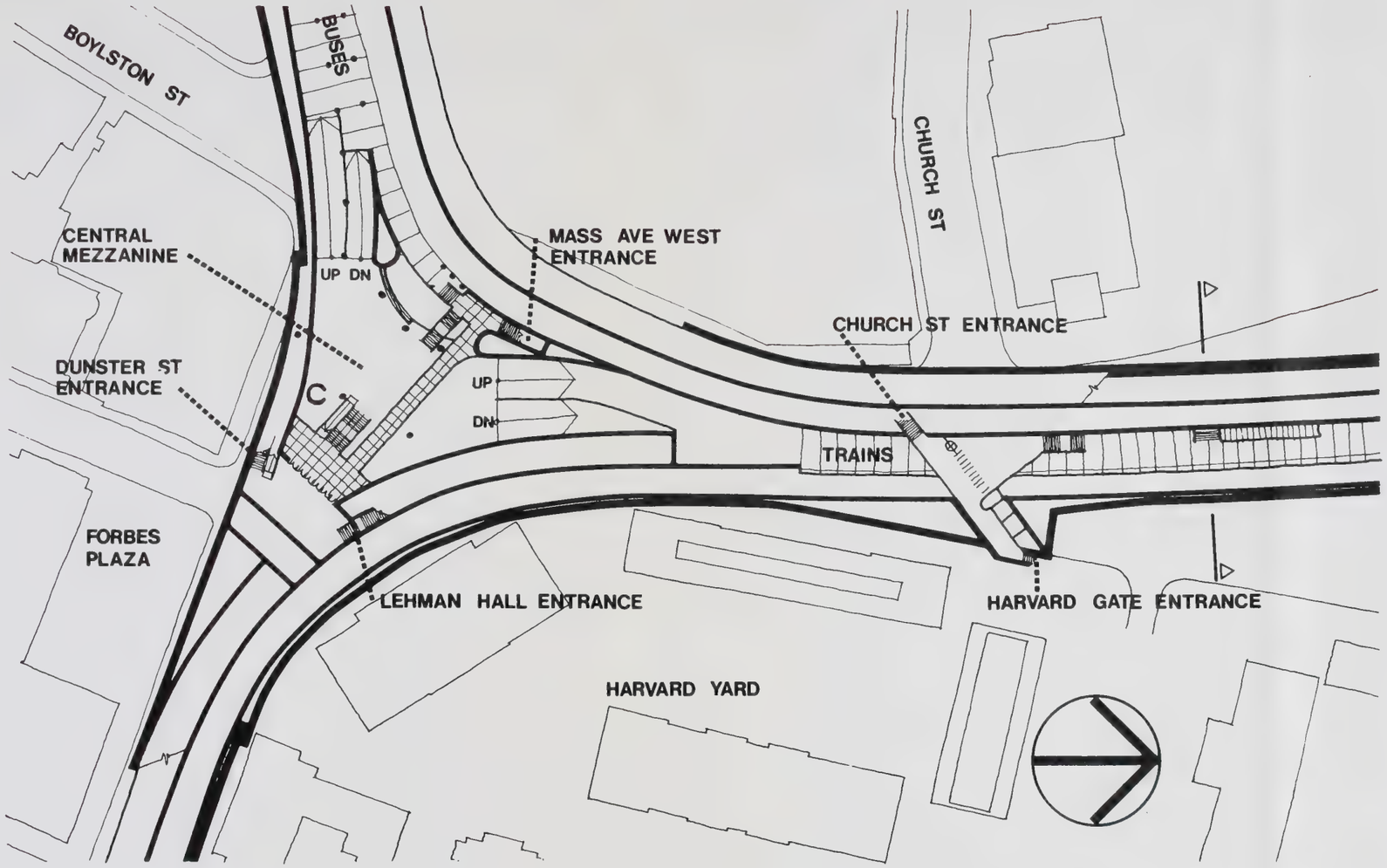
17 GANNETT HOUSE
18 HEMENWAY GYM
19 HASTING HALL
20 HARVARD-EPWORTH METHODIST CHURCH
21 FIRST CHURCH UNITARIAN

MISCELLANEOUS

22 MEMORIAL FENCE
23 BRASS PLATES

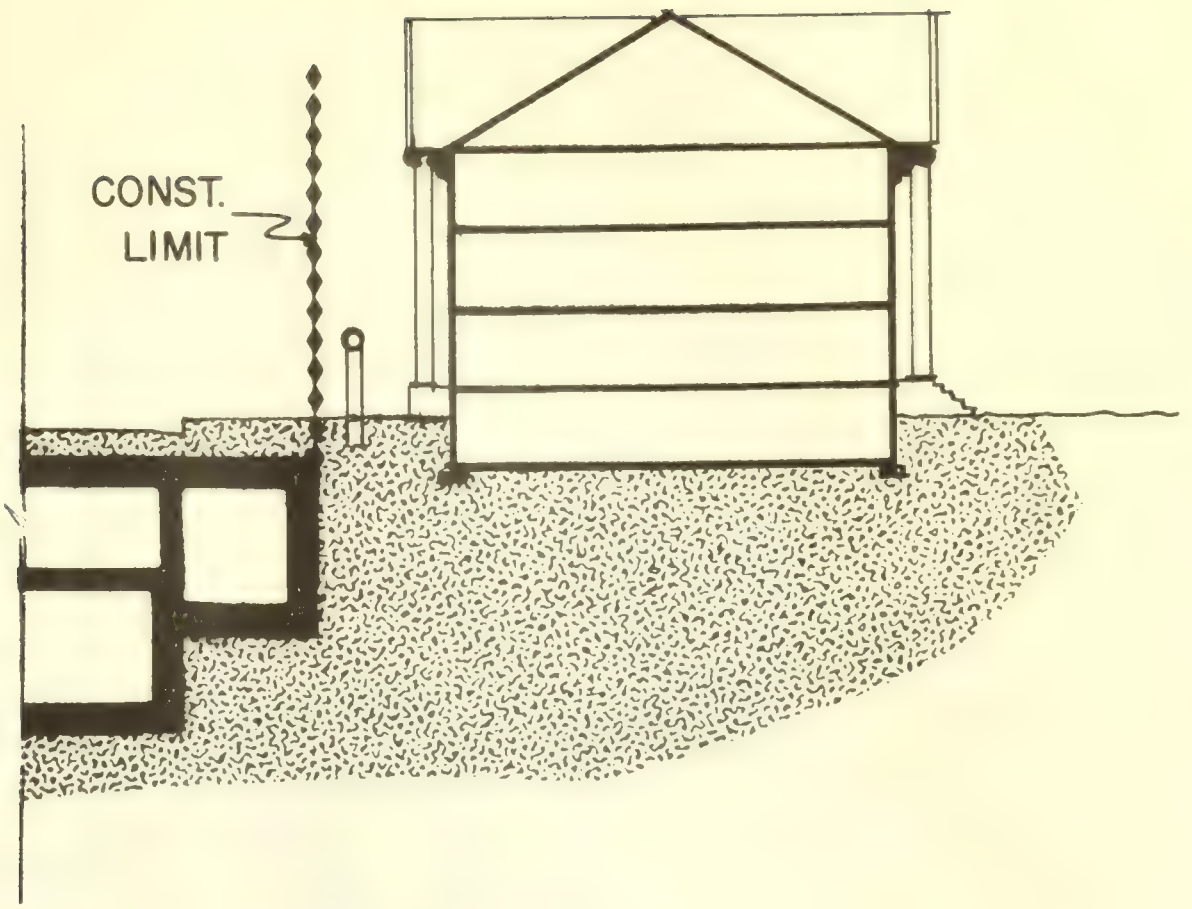
EXHIBIT G



Source: Skidmore, Owings & Merrill

EXHIBIT I DELETED

EXHIBIT I



DIAGRAMMATIC CROSS SECTIONS

ABOVE: AT LEHMAN HALL

BELOW: AT STRAUS HALL

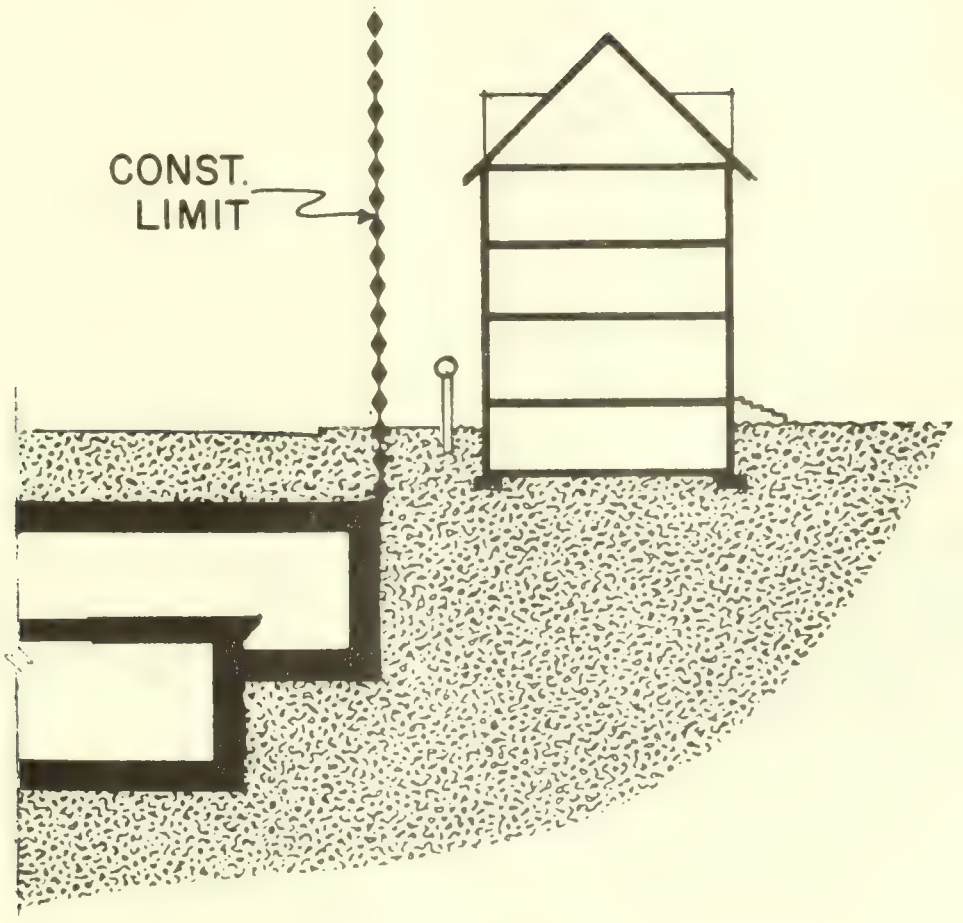
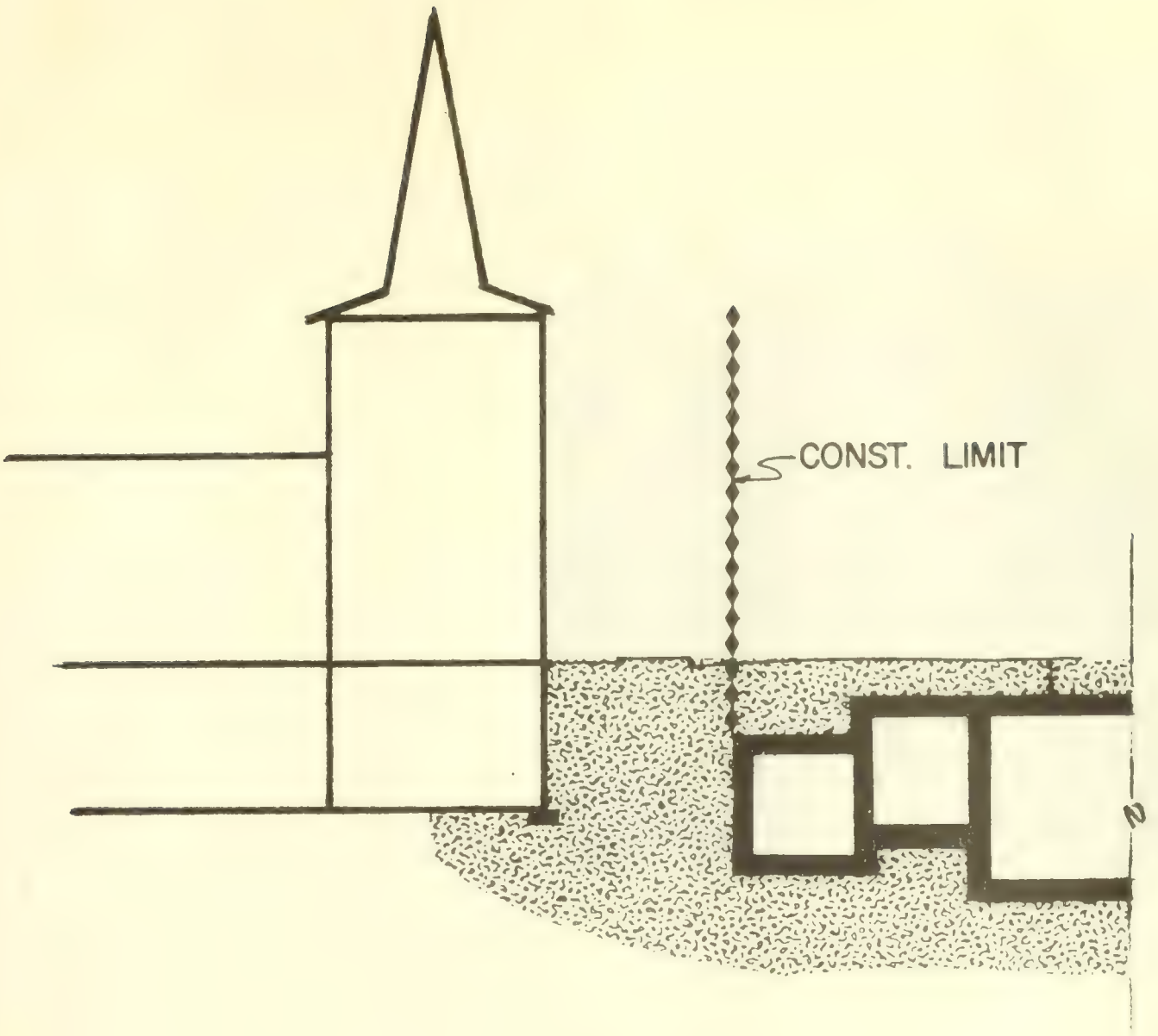


EXHIBIT J-1



DIAGRAMMATIC CROSS SECTIONS

ABOVE: AT FIRST CHURCH UNITARIAN

BELOW: AT HEMMENWAY GYMNASIUM

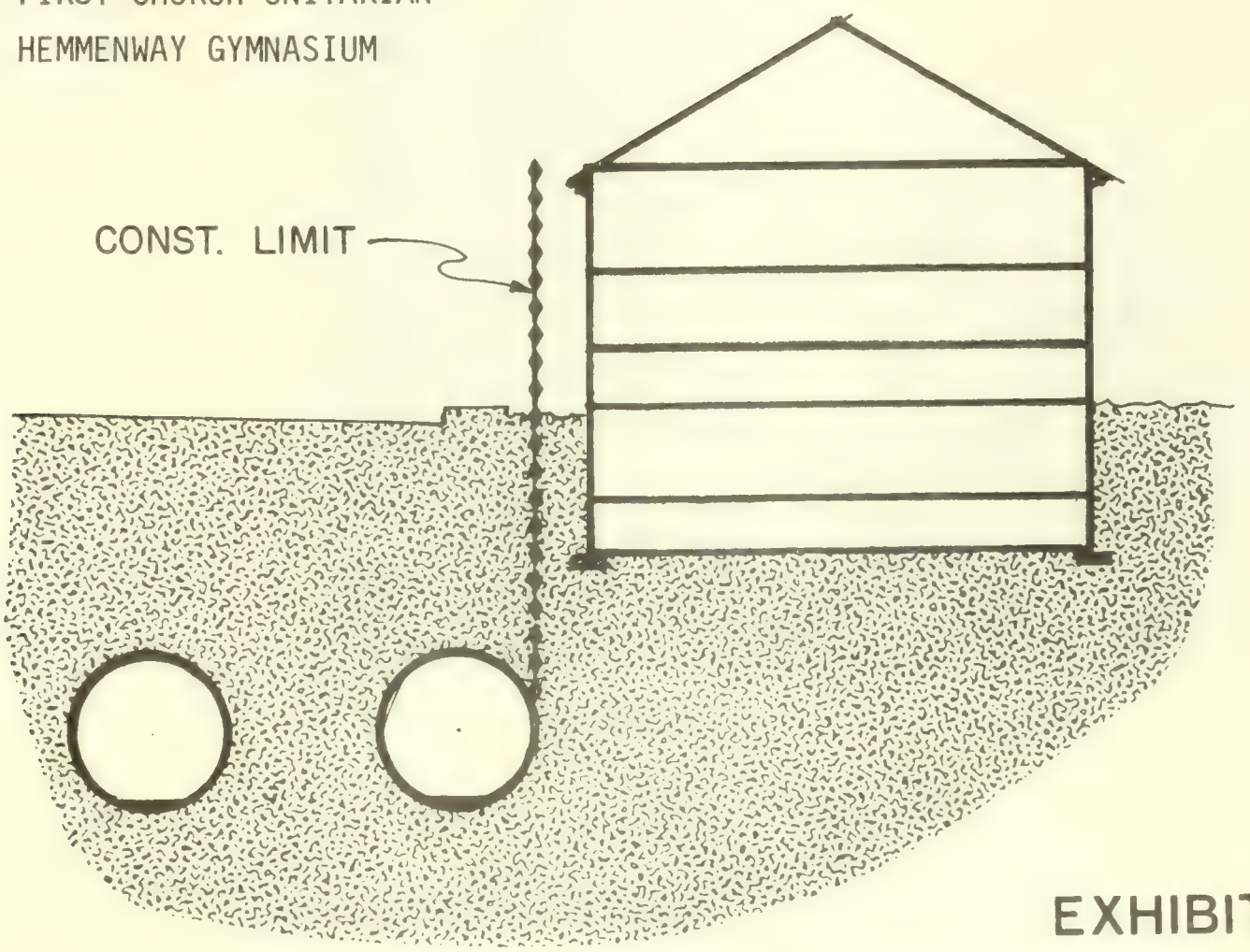


EXHIBIT J-2

View of
Harvard Square

Harvard Square looking toward Harvard Yard. Lehman, Strauss and Mathews Halls are in background. Subway Kiosk and newsstand are at center.

EXHIBIT K-1

View of subway entrance in fence at Lehman Hall.

Subway entrance at Wadsworth House (lower right)

EXHIBIT K-2

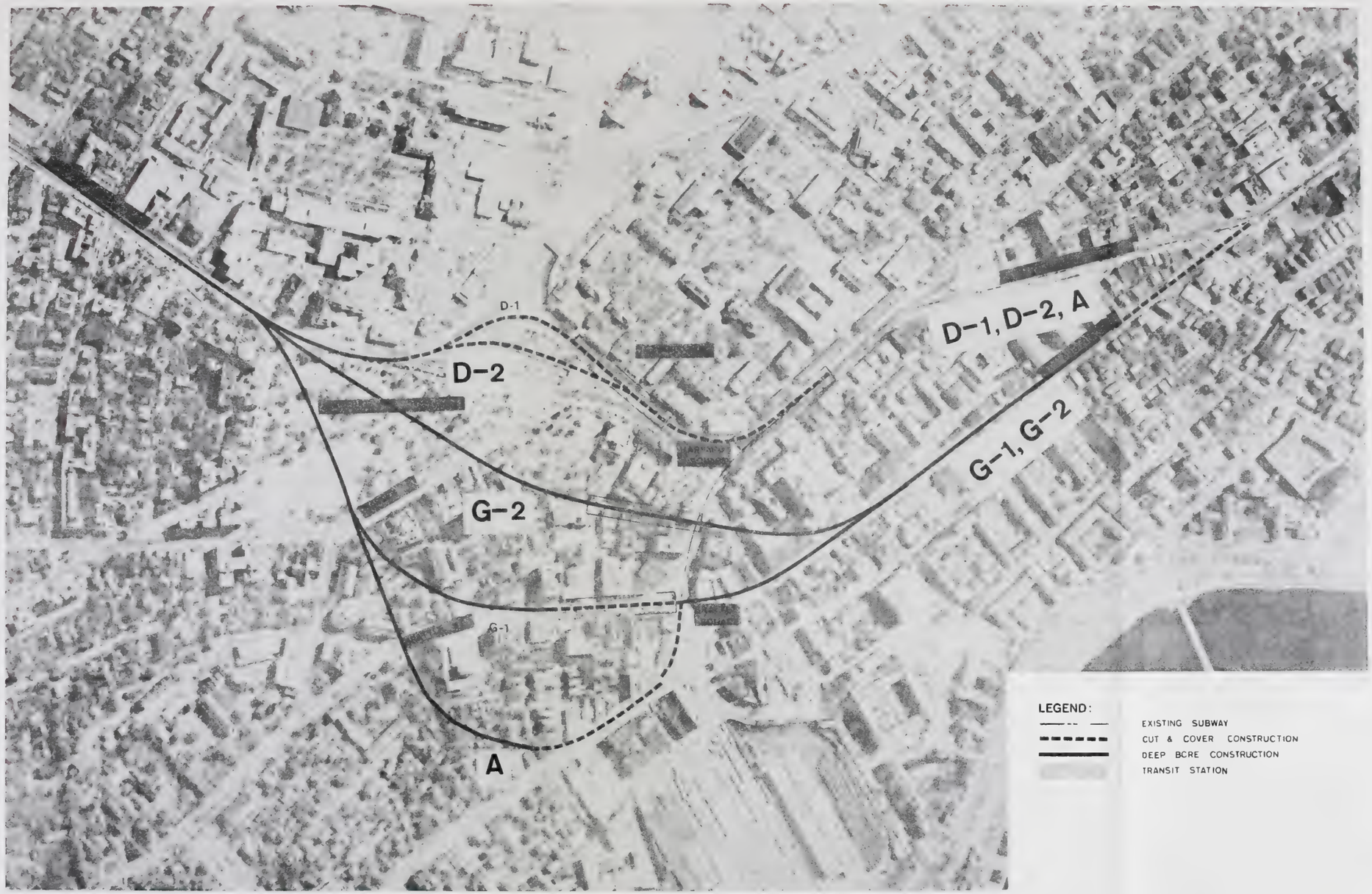
Harvard Square looking toward Lehman Hall. Fencing and gate would be temporarily removed to construct new tunnels.

EXHIBIT K-3

Statue of General Sumner, terrace and wall in Flagstaff Park. These would be removed and restored during subway construction.

Flagpole in Flagstaff Park. Pole would be temporarily removed. Trees on the left would be replaced.

EXHIBIT K-4



Massachusetts Bay Transportation Authority

HARVARD SQUARE
ALTERNATIVE ALIGNMENTS

0 FEET

EXHIBIT L

LONG TERM (OPERATIONAL)	LINE A	LINE D-1 (D-2) PROJECT	LINE G-1	LINE G-2
A. RAPID TRANSIT CRITERIA				
1. GEOMETRICS	CURVES RANGING FROM 320 FT. TO 450 FT. RADII ARE BELOW DESIRABLE STANDARDS (500' MIN. RADIUS)--INCREASES TRACK MAINTENANCE, AND RESTRICTS OPERATING SPEEDS. GRADE IS SLIGHTLY STEEPER THAN DESIRABLE 3%. DEFINITE WHEEL SQUEAL AT HARVARD SQUARE, ELIOT SQUARE AND HILLIARD ST., BUT INTENSITY CAN BE CONTROLLED.	D-1 ALIGNMENT REQUIRES CURVES OF 250 FT. AND 350 FT. RADII--ALL BELOW DESIRABLE STANDARD OF 500 FT. MIN. RADIUS--INCREASES TRACK MAINTENANCE AND RESTRICTS OPERATING SPEEDS. STATION IS ON 1/2% GRADE VS. DESIRABLE LEVEL PROFILE. DEFINITE WHEEL SQUEAL AT HARVARD SQUARE AND FLAGSTAFF PARK, BUT INTENSITY CAN BE CONTROLLED. D-2 IS SIMILAR BUT FLATTER CURVES NORTH OF STATION IMPROVES GEOMETRICS.	THEORETICALLY "SMOOTH" ALIGNMENT, NO SUBSTANDARD CURVES OR GRADES, BUT 6 RISES WILL RESTRICT OPERATING SPEEDS. WHEEL SQUEAL IS PROBABLE AT EACH END OF STATION BUT INTENSITY CAN BE CONTROLLED.	BEST GEOMETRY OF ALTERNATIVES STUDIED. NO SUBSTANDARD CURVES OR GRADES. AFFECT ON OPERATING SPEED IS MINIMAL. POSSIBLE WHEEL SQUEAL EACH END OF STATION BUT INTENSITY CAN BE CONTROLLED.
2. RUNNING TIME (CENTRAL SQ.) (TO) (PORTER SQ.)	4 MINUTES 40 SECONDS	4 MINUTES 23 SECONDS (D-1) 4 MINUTES 17 SECONDS (D-2)	4 MINUTES 17 SECONDS	4 MINUTES 0 SECONDS
3. INTERFACE WITH BUS SERVICE	EXISTING UNDERGROUND ARRANGEMENT UNCHANGED. INTERCONNECTION IS GENERALLY DIRECT BUT SPATIALLY CONFUSING.	EXISTING UNDERGROUND BUSWAYS USED. (WAITING SPACES MODIFIED.) BUS PASSENGER AREAS ARE PHYSICALLY AND VISUALLY INTEGRATED WITH TRANSIT MEZZANINE LEVELS. MOST DIRECT RELATIONSHIP OF STATION ALTERNATES STUDIED.	COMPARABLE TO G-2. HORIZONTAL DISTANCES BETWEEN TRANSIT MODES ARE SOMEWHAT GREATER BUT VERTICAL DISTANCES ARE LESS.	EXISTING UNDERGROUND BUSWAYS USED. (WAITING SPACES MODIFIED AND CENTERED NEAR PALMER STREET.) ADJOINING TUNNEL SPACE FROM KIOSK AREA TO BRATTLE SQ. BECOMES "FREE" CONCOURSE. CONCEPT REQUIRES TWO OR MORE VERTICAL MOVEMENTS TO REACH TRAIN LEVEL FROM BUS AREAS, BUT MOVEMENTS ARE UNCOMPLICATED.
4. CROSSOVER PROVISIONS	EXISTING CROSSOVER PROVISIONS RETAINED.	CROSSOVER PROVIDED NORTH OF NEW STATION.	CROSSOVER FEASIBLE BUT NOT PLANNED. WOULD REQUIRE ADDITIONAL CUT-AND-COVER WORK TO GUTMAN LIBRARY.	NONE PLANNED. IMPRACTICAL IN DEEP-BORE CONSTRUCTION.
5. TRAIN STORAGE	CAN BE IN EXISTING TUNNEL FROM BRATTLE SQUARE TO ELIOT YARD PORTAL.	INBOUND TRACK CONNECTION TO EXISTING TUNNEL WEST OF HARVARD SQUARE REMAINS. TUNNEL COULD BE UTILIZED FOR TRAIN STORAGE.	BOTH TRACKS COULD MAINTAIN DIRECT CONNECTION TO EXISTING TRANSIT AT PUTNAM SQUARE. POSSIBLE TO USE THIS TUNNEL FOR TRAIN STORAGE.	SAME AS G-1
6. LAYUP TRACK	CAN BE IN EXISTING TUNNEL FROM BRATTLE SQUARE TO ELIOT YARD PORTAL.	USE OF ONE TRACK IN ABANDONED TUNNEL IS PROPOSED. A LAY-UP TRACK NORTH OF STATION IS PREFERABLE BUT IS NOT PLANNED.	POSSIBLE TO USE ABANDONED TRACKAGE WEST OF PUTNAM SQUARE. A LAYUP TRACK NORTH OF STATION IS PREFERABLE BUT IS NOT PLANNED.	SAME AS G-1
B. BUS SERVICE				
1. THROUGH ROUTES AND TERMINUS ROUTES	TRANSIT EXTENSION WILL REDUCE DAILY BUS VOLUME BY ABOUT 50%. THROUGH-ROUTING OF ALL LINES, WITH NO HOLDOVER, IS PROPOSED. THE EXCEPTION IS THE DUDLEY STATION ROUTE WHICH WILL TERMINATE AND RETURN.	SAME AS A	SAME AS A	SAME AS A
C. PASSENGER POTENTIAL				
1. RAPID TRANSIT STATION / BUS PLATFORM	CLOSE TO CENTERS OF PROJECTED EMPLOYMENT AND RESIDENT POPULATION WITHIN A 1/2 MILE RADIUS.	CLOSE TO CENTERS OF PROJECTED EMPLOYMENT AND 1/2 MILE POPULATION RADIUS.	CLOSEST TO PROJECTED EMPLOYMENT CENTER AND 1/4 MILE POPULATION CENTER.	CLOSEST TO CENTER OF COMMERCIAL FLOOR SPACE AND PROJECTED 1/4 MILE POPULATION RADIUS.
D. IMPACTS				
1. SURFACE TRAFFIC { PEDESTRIAN VEHICULAR BICYCLE	MAIN ENTRANCE MUST REMAIN AT OR NEAR PRESENT LOCATION. PEDESTRIAN-VEHICULAR CONFLICT COULD BE REDUCED BY MODIFYING STREET PATTERNS AND ANNEXING ENTRANCE TO EITHER THE SOUTH OR WEST SIDES OF THE SQUARE. CONSIDERABLE STREET AREA COULD THEREBY CONVERT TO PEDESTRIAN SPACE.	EXISTING KIOSK AND ISLAND CAN BE ELIMINATED. ENTRANCES IN HARVARD SQUARE ARE POSSIBLE AT PERIPHERAL LOCATIONS AND IN BRATTLE STREET (NEAR PALMER). MODIFIED TRAFFIC PATTERNS AND ENLARGED PEDESTRIAN AREAS ARE NEEDED FOR OPTIMUM EFFECTIVENESS.	TWO OR MORE ENTRANCES REQUIRED ALONG HARVARD SQUARE-BRATTLE SQUARE AXIS. ACCESS LOCATIONS ARE ADAPTABLE TO PRESENT TRAFFIC PATTERNS (WITH SOME MODIFICATION OF CURB LINES), BUT CLOSING OF BRATTLE STREET FROM CHURCH STREET TO KIOSK AREA WOULD PROVIDE BETTER DESIGN OPTIONS ABOVE AND BELOW GROUND.	SAME AS G-1, EXCEPT MAIN ENTRANCE WOULD BE OFF-STREET (CORNER OF BRATTLE AND PALMER STREET).
2. SOCIO-ECONOMIC CONDITIONS	SEE CHAPTER V			
3. BUILDINGS / RESIDENCES	LINE CROSSES UNDER OR ADJACENT SENSITIVE BUILDINGS SUCH AS HARVARD DORMS ALONG MASSACHUSETTS AVE., HILLIARD ST. RESIDENCES, LOEB DRAMA CENTER, RADCLIFFE YARD BUILDINGS AND EPWORTH CHURCH. EXTENSIVE NOISE AND VIBRATION CONTROLS ARE NECESSARY.	LINE IS ADJACENT TO SEVERAL SENSITIVE BUILDINGS SUCH AS HARVARD DORMS ALONG MASSACHUSETTS AVE. AND PEABODY ST., THE LITTAUER CENTER, GANNETT HOUSE, EPWORTH CHURCH, AND THE UNITARIAN CHURCH. INTERMEDIATE NOISE AND VIBRATION CONTROLS ARE NECESSARY BUT LEAST OF ALTERNATES STUDIED.	LINE CROSSES UNDER OR ADJACENT SENSITIVE BUILDINGS SUCH AS ST. PAUL'S CHURCH, BRATTLE THEATER AREA, LOEB DRAMA CENTER, RADCLIFFE YARD BUILDINGS, GUTMAN LIBRARY, AND EPWORTH CHURCH. EXTENSIVE NOISE AND VIBRATION CONTROLS ARE NECESSARY.	LINE CROSSES UNDER OR ADJACENT SENSITIVE BUILDINGS SUCH AS ST. PAUL'S CHURCH, CHRIST CHURCH AND EPWORTH CHURCH. INTERMEDIATE NOISE AND VIBRATION CONTROLS ARE NECESSARY.
4. HISTORIC SITES	ALIGNMENT CROSSES UNDER FAY HOUSE AND BYERLY HALL BOTH WITHIN THE CAMBRIDGE COMMON HISTORIC DISTRICT/NATIONAL REGISTER OF HISTORIC PLACES. EXTENSIVE NOISE AND VIBRATION CONTROLS ARE NECESSARY TO NEGATE IMPACTS.	ALIGNMENT IS WITHIN THE CAMBRIDGE COMMON HISTORIC DISTRICT, AND ADJACENT TO THE OLD HARVARD YARD HISTORIC DISTRICT, BOTH ON THE NATIONAL HISTORIC REGISTER. INTERMEDIATE NOISE AND VIBRATION CONTROLS ARE NECESSARY.	ALIGNMENT CROSSES UNDER FAY HOUSE AND BYERLY HALL BOTH WITHIN THE CAMBRIDGE COMMON HISTORIC DISTRICT/NATIONAL REGISTER OF HISTORIC PLACES AND ADJACENT TO OTHER NATIONAL HISTORIC SITES AS THE WILLIAM BRATTLE HOUSE AND THE VILLAGE BLACKSMITH. SEVERAL SITES OF LOCAL HISTORICAL SIGNIFICANCE SUCH AS ST. PAUL'S CHURCH, LAMPOON BUILDING AND LONGFELLOW HALL ADJACENT TO THE ALIGNMENT. EXTENSIVE NOISE AND VIBRATION CONTROLS ARE NECESSARY.	ALIGNMENT CROSSES UNDER CHRIST CHURCH WHICH IS WITHIN THE CAMBRIDGE COMMON HISTORIC DISTRICT/NATIONAL REGISTER OF HISTORIC PLACES. SEVERAL SITES OF LOCAL SIGNIFICANCE ADJACENT TO ALIGNMENT SUCH AS ST. PAUL'S CHURCH, LAMPOON BUILDING, 31 CHURCH STREET (FORMER POLICE STATION) AND 26 CHURCH STREET. INTERMEDIATE NOISE AND VIBRATION CONTROLS ARE NECESSARY.
5. RECREATION AREAS	ALIGNMENT CROSSES UNDER CAMBRIDGE COMMON. NO ADVERSE IMPACT IS ANTICIPATED.	AN EMERGENCY EXIT PRESENTLY CONTEMPLATED WITHIN FLAGSTAFF PARK. POTENTIAL FOR COMBINED EAST-WEST BUS STOP AND TRANSIT ENTRANCE.	THE ALIGNMENT CROSSES UNDER CAMBRIDGE COMMON AND ADJACENT TO WINTHROP SQUARE. NO ADVERSE IMPACT IS ANTICIPATED.	ALIGNMENT CROSSES UNDER CAMBRIDGE COMMON. NO ADVERSE IMPACT IS ANTICIPATED.
6. ECOLOGY	NO ADVERSE ECOLOGIC IMPACT IS ANTICIPATED.	LOSS OF TREES IN FLAGSTAFF PARK UNDER D-2	SAME AS A	SAME AS A

EXHIBIT M-1

Massachusetts Bay Transportation Authority

HARVARD SQUARE
AREA ALTERNATIVES
SUMMARY OF IMPACTS

SHORT TERM (CONSTRUCTION)	LINE A	LINE D-1 (D-2) PROJECT	LINE G-1	LINE G-2
A. IMPACTS				
1. TRANSIT (RAIL) SERVICE	RAIL SERVICE INTERRUPTED IN MAKING CONNECTION TO EXISTING TRACKS AT BRATTLE SQUARE AND EXTENDING PLATFORMS. WORK COULD BE ACCOMPLISHED DURING OFF-PEAK PERIODS EITHER AT NIGHT OR A WEEKEND. SOME "SLOW DOWN" IN OPERATION FOR ABOUT 8 MONTHS.	PROPER CONSTRUCTION SCHEDULING NECESSARY TO MAINTAIN TWO-TRACK SERVICE. OFF-HOUR WORK WITHIN THE TUNNEL AND TRANSIT SERVICE STOPPAGE LIMITED TO ONE OR TWO WEEKENDS/HOLIDAYS.	RAIL SERVICE INTERRUPTED IN MAKING CONNECTION TO EXISTING TRACKS AT PUTNAM SQUARE AT PROPOSED OFF-PEAK HOURS. SOME DISRUPTION IN THE EXISTING BRATTLE SQUARE TUNNEL BUT SHOULD NOT AFFECT SERVICE.	SAME AS G-1
2. BUS SERVICE	PRESENT LEVEL OF SERVICE CAN BE MAINTAINED. CUT-AND-COVER TUNNEL WORK NEAR THE MT. AUBURN STREET INCLINE WILL CREATE TEMPORARY CONFLICTS.	BUS SERVICE UNDERGROUND CAN BE RETAINED DURING MOST OF CONSTRUCTION PERIOD. NORTHBOUND (UPPER) BUS TUNNEL WILL BE OUT OF USE FOR ABOUT 6 MONTHS AND ALTERNATE ROUTINGS TO OTHER TRANSIT STATIONS AND STOPS WILL BE REQUIRED. PASSENGER STOPS ON THE SURFACE IN HARVARD SQUARE MUST BE RELOCATED TO OTHER AREAS SUCH AS BRATTLE STREET AND CAMBRIDGE COMMON. D-2 IMPACTS ARE SIMILAR EXCEPT BUS TUNNEL USE WOULD BE CURTAILED IN TOTAL FOR ABOUT 12 MONTHS.	MINIMAL INTERFERENCE WITH USE OF BUSWAY TUNNELS. RENOVATION OF EXISTING TUNNEL SPACES WILL CAUSE TEMPORARY INCONVENIENCE TO BUS PASSENGERS. LEVEL OF SERVICE UNAFFECTED.	SAME AS G-1
3. PASSENGER FACILITIES	MINOR INCONVENIENCES TO PASSENGERS DURING STATION MODERNIZATION WORK. PLATFORM EXTENSIONS WILL NOT INTERFERE WITH TRAIN BOARDINGS.	TEMPORARY TWO LEVEL STATION AND KIOSK REQUIRED OPPOSITE EXISTING PLATFORMS. TRANSFER TO BUSSES WOULD BE VIA SURFACE TO EXISTING KIOSK AND DOWN TO BUSWAYS. VARYING ACCESS AND CIRCULATION IMPROVISATIONS THROUGH CONSTRUCTION AREAS WILL CAUSE SOME INCONVENIENCE TO TRAIN/BUS PATRONS.	NO IMPORTANT AFFECT ON EXISTING FUNCTIONS UNTIL NEW STATION IS IN SERVICE. REMODELING OF ABANDONED TUNNELS MAY INCONVENIENCE BUS PASSENGERS.	SAME AS G-1
4. SURFACE TRAFFIC (PEDESTRIAN / VEHICULAR / BICYCLE)	DISRUPTION TO VEHICULAR TRAFFIC IN THE CUT-AND-COVER SECTIONS ON MT. AUBURN ST. BETWEEN HILLIARD ST. AND BRATTLE SQ., AND MASSACHUSETTS AVE. BETWEEN HOLYOKE AND LINDEN STREETS. TWO MOVING LANES CAN BE MAINTAINED WITH NO PARKING. PEDESTRIANS ABLE TO WALK ALONG THE AREA BEING INCONVENIENCED BY WORK. RELOCATION OF KIOSK, IF IMPLEMENTED WILL DISRUPT MASSACHUSETTS AVE. TRAFFIC.	THREE AREAS OF SURFACE CONSTRUCTION AFFECT VEHICULAR MOVEMENT AND PARKING: (1) TEMPORARY STATION (NEAR HOLYOKE CENTER), (2) NEW SUBWAY TUNNEL FROM ABOUT HOLYOKE STREET ALONG HARVARD YARD TO CAMBRIDGE ST. AND MASSACHUSETTS AVE. AT THE COMMON, (3) RESTRUCTURING EXISTING TUNNEL IN KIOSK AREA TO ACCOMMODATE PASSENGER TRANSFER FACILITIES. IT IS PROPOSED TO REROUTE AS MUCH TRAFFIC AS POSSIBLE FROM THE AREA BY USING TRAFFIC ENGINEERING TECHNIQUES SUCH AS ONE-WAY STREETS, INTERSECTION CONTROLS. A MINIMUM OF TWO MOVING TRAFFIC LANES WILL BE MAINTAINED IN HARVARD SQUARE AT ALL TIMES. CONSTRUCTION WILL BE STAGED IN SEGMENTS COMPATIBLE WITH TRAFFIC MOVEMENTS. PEDESTRIAN MOVEMENT ALONG HARVARD YARD WEST FENCE ELIMINATED DURING CONSTRUCTION. PEDESTRIAN MOVEMENT IN THE SQUARE INCONVENIENCED. D-2 SIMILAR EXCEPT NEW BUS TUNNEL BETWEEN CHURCH STREET AND FLAGSTAFF PARK WILL BE BUILT AND SUBWAY WORK WILL BE WITHIN FLAGSTAFF PARK AND NOT ON PEABODY STREET.	TWO MAJOR AREAS OF SURFACE DISRUPTION: (1) BRATTLE STREET BETWEEN THE SQUARE AND STORY STREET. DESIRABLE TO ELIMINATE VEHICULAR TRAFFIC FROM THIS AREA FOR THE CONSTRUCTION PERIOD. PROVISIONS FOR SERVICE VEHICLES AND THE LIKE CAN BE MADE. PEDESTRIAN TRAFFIC INCONVENIENCED BY THE CONSTRUCTION WHICH WILL EXTEND FROM BUILDING LINE TO BUILDING LINE. PEDESTRIAN WAYS. ACCESS TO STORES MAINTAINED THROUGH PROPER PHASING OF THE WORK. (2) FROM PUTNAM SQ. TO ABOUT ATHENS ST. ALONG MT. AUBURN. CUT-AND-COVER WORK IN THIS AREA. ACCESS SHAFT FOR THE DEEP-BORE TUNNEL CONSTRUCTED EAST OF ATHENS ST. THIS REQUIRES CLOSING MT. AUBURN ST. IN THIS AREA FOR THE TOTAL LENGTH OF CONSTRUCTION--APPROXIMATELY 2 YEARS. ISOLATED CONSTRUCTION WORK WHERE BUILDINGS UNDERPINNED. SOME DISRUPTION AROUND THE PARTICULAR STRUCTURE.	THREE AREAS OF DISRUPTION: (1) FROM PUTNAM SQ. TO ABOUT ATHENS ST. ALONG MT. AUBURN ST. CUT-AND-COVER WORK IN THIS AREA. ACCESS SHAFT FOR THE DEEP-BORE TUNNEL CONSTRUCTED EAST OF ATHENS ST. THIS REQUIRES CLOSING MT. AUBURN ST. IN THIS AREA FOR THE TOTAL LENGTH OF CONSTRUCTION--APPROXIMATELY 2 YEARS. (2) PALMER AND BRATTLE STREETS. CONSTRUCTION OF STATION FACILITIES WILL TAKE PLACE OFF THE PAVED STREETS EXCEPT FOR WHATEVER WIDTH OF BRATTLE ST. USED BY CONSTRUCTION EQUIPMENT. (3) CHURCH AND PALMER STREETS, CHURCH ST. GARAGE. THIS LOCATION WILL SERVE AS THE ACCESS SHAFT FOR THE TUNNELING OF THE STATION. ISOLATED CONSTRUCTION WORK WHERE BUILDINGS UNDERPINNED. SOME DISRUPTION AROUND THE PARTICULAR STRUCTURE.
5. SOCIO-ECONOMIC CONDITIONS	SEE MAJOR ISSUES SECTION, THIS BROCHURE			
6. LAND TAKINGS / EASEMENTS	REQUIRES ACQUISITION OF PROPERTY AT 129 MT. AUBURN STREET. PERMANENT EASEMENTS FROM 15 PROPERTIES LOCATED BETWEEN MT. AUBURN STREET AND THE CAMBRIDGE COMMON.	A STRIP OF LAND WILL BE TAKEN FROM HARVARD YARD IN FRONT OF LEHMAN HALL BETWEEN WADSWORTH HOUSE AND STRAUSS HALL.	NO LAND TAKING IS REQUIRED. PERMANENT EASEMENTS REQUIRED FROM 24 PROPERTIES BETWEEN PUTNAM SQ. AND BRATTLE SQ. AND FROM GUTMAN LIBRARY THROUGH RADCLIFFE YARD.	TWO PROPERTIES TAKEN--CHURCH STREET GARAGE AND ZUM-ZUM RESTAURANT AT PALMER AND BRATTLE STREET. PERMANENT EASEMENTS REQUIRED FROM 31 PROPERTIES BETWEEN PUTNAM SQUARE AND THE CAMBRIDGE COMMON.
7. BUILDINGS / RESIDENCES	A NUMBER OF STRUCTURES AFFECTED BY THE CONSTRUCTION. TWO CATEGORIES OF STRUCTURES HAVE BEEN IDENTIFIED (1) MAJOR STRUCTURES REQUIRING UNDERPINNING: IN THIS GROUPING INCLUDES LOEB DRAMA CENTER, SCHLESINGER LIBRARY, FAY HALL, BYERLY HALL (2) MINOR STRUCTURES WHERE UNDERPINNING IS QUESTIONABLE DUE TO THE TYPE OF FOUNDATION AND STRUCTURE; THIS GROUPING INCLUDES WOOD FRAME RESIDENCES ALONG MT. AUBURN STREET (NOS. 131 AND 133), HILLIARD STREET (13, 13-1/2, 15, 17, 18 AND 20) AND FULLER PLACE (55, 56 AND 65) AND BUCKINGHAM. SEE MAJOR ISSUES DISCUSSION.	ALL BUILDINGS ADJACENT TO THE CONSTRUCTION WILL BE PROTECTED TO PREVENT ANY MOVEMENT. STRUCTURES WHERE UNDERPINNING IS QUESTIONABLE INCLUDES EPWORTH CHURCH, ROSCOE POUND BUILDING, WIETH HALL AND EVERETT ST. GARAGE. SEE MAJOR ISSUES DISCUSSION.	A NUMBER OF STRUCTURES AFFECTED BY THE CONSTRUCTION. TWO CATEGORIES OF STRUCTURES HAVE BEEN IDENTIFIED: (1) MAJOR STRUCTURES REQUIRING UNDERPINNING; THIS GROUP INCLUDES ST. PAUL'S CHURCH, LAMPOON BUILDING, THE GARAGE, 1039 MASS. AVE., HOLYOKE CENTER, 95-101 MT. AUBURN ST., 2 MT. AUBURN ST., 25 MT. AUBURN ST., DESIGN RESEARCH, GUTMAN LIBRARY, QUINCY HOUSE DORM, LONGFELLOW HALL, FAY HOUSE, BYERLY HOUSE, 60 BRATTLE ST., and 51 MT. AUBURN ST. (2) MINOR STRUCTURES WHERE UNDERPINNING IS QUESTIONABLE DUE TO THE TYPE OF STRUCTURE AND FOUNDATION, THIS GROUPING INCLUDES 32-36 MT. AUBURN ST., 51-53 MT. AUBURN ST., 62-64 MT. AUBURN ST., 70-72 MT. AUBURN ST., 67-73 MT. AUBURN ST., 82 MT. AUBURN ST., 74-76 MT. AUBURN ST., 52 BRATTLE ST., 54 BRATTLE ST. SEE MAJOR ISSUES DISCUSSION.	A NUMBER OF STRUCTURES AFFECTED BY THE CONSTRUCTION. TWO CATEGORIES OF STRUCTURES HAVE BEEN IDENTIFIED: (1) MAJOR STRUCTURES REQUIRING UNDERPINNING, THIS GROUPING INCLUDES ST. PAUL'S CHURCH, LAMPOON BUILDING, QUINCY HOUSE DORM, 25 MT. AUBURN ST., THE GARAGE, ABBOT BUILDING, 1039 MASS. AVE., HARVARD COOP AND ANNEX, HOLYOKE CENTER, AND 2 MT. AUBURN ST.; (2) MINOR STRUCTURES WHERE UNDERPINNING IS QUESTIONABLE DUE TO THE TYPE OF STRUCTURE AND FOUNDATION, THIS GROUPING INCLUDES CHRIST CHURCH AND RECTORY, 32-36 MT. AUBURN ST., 62-64 MT. AUBURN ST., 70-72 MT. AUBURN ST., 74-76 MT. AUBURN ST., 51-53 MT. AUBURN ST., AND 67-73 MT. AUBURN ST.
8. HISTORIC SITES	TUNNELS CROSS UNDER FAY HOUSE AND BYERLY HOUSE BOTH ARE WITHIN CAMBRIDGE COMMON HISTORICAL DISTRICT--A NATIONAL REGISTER SITE. IT IS PROPOSED TO UNDERPIN THESE STRUCTURES. SEE MAJOR ISSUES DISCUSSION.	LAND TAKEN FROM HARVARD YARD IS WITHIN THE OLD HARVARD YARD HISTORIC DISTRICT-NATIONAL REGISTER OF HISTORIC SITE. THE BRICK WALL IN FRONT OF LEHMAN HALL WILL BE TORN DOWN. THE WALL AND PROPERTY TO BE RESTORED TO EXISTING CONDITION. SEE MAJOR ISSUES DISCUSSION.	TUNNEL CROSSES UNDER FAY HOUSE, BYERLY HOUSE, BOTH WITHIN THE CAMBRIDGE COMMON HISTORICAL DISTRICT. ALSO ADJACENT TO SEVERAL STRUCTURES OF LOCAL HISTORICAL SIGNIFICANCE: ST. PAUL'S CHURCH, LAMPOON BUILDING, LONGFELLOW HALL AND NATIONAL REGISTER SITES: WILLIAM BRATTLE HOUSE AND BRATTLE HALL. SEE MAJOR ISSUES DISCUSSION.	TUNNEL CROSSES UNDER CHRIST CHURCH, OLD BURYING GROUND, BOTH WITHIN THE CAMBRIDGE COMMON HISTORICAL DISTRICT. ALSO ADJACENT TO SEVERAL STRUCTURES OF LOCAL HISTORICAL SIGNIFICANCE: ST. PAUL'S CHURCH, LAMPOON BUILDING, AND 26 CHURCH STREET. SEE MAJOR ISSUES DISCUSSION.
9. RECREATION AREAS	TUNNEL PASSES UNDER THE CAMBRIDGE COMMON. NO SURFACE IMPACT IS ANTICIPATED.	FLAGSTAFF PARK INDIRECTLY AFFECTED BY D-1 ALTERNATE. PROBABLY NEEDED FOR ANCILLARY CONSTRUCTION SPACE. D-2 ALTERNATE INVOLVES CONSTRUCTION IN PARK AREA. PARK CAN BE RESTORED TO PRESENT OR BETTER CONDITION IN EITHER CASE.	TUNNEL PASSES UNDER CAMBRIDGE COMMON AND ADJACENT WINTHROP SQUARE. NO SURFACE IMPACT IS ANTICIPATED.	SAME AS G-1
10. ECOLOGY	NO ECOLOGICAL IMPACT ANTICIPATED. TUNNEL STRUCTURE LOCATED WITHIN CLAY, SAND AND CLAY AND TILL STRATAS, AND BELOW A PERCHED WATER TABLE.	NO ECOLOGICAL IMPACT ANTICIPATED. IT IS OUR UNDERSTANDING THAT TREES IN HARVARD YARD WERE AFFECTED BY DEWATERING FOR THE CONSTRUCTION OF THE EXISTING SUBWAY. DEWATERING FOR PROPOSED CONSTRUCTION WILL BE CLOSELY MONITORED TO MAINTAIN SAFE LEVELS FOR PLANT LIFE IN HARVARD YARD.	SAME AS A	SAME AS A
11. UTILITY SERVICE	THE FOLLOWING UTILITIES ARE TO BE RELOCATED: (1) MT. AUBURN STREET AREA - 12 IN. AND 6 IN. WATERLINE, 8 IN. GAS LINE, 36 IN. MDC SEWER, 19 IN. X 20 IN. COMBINED SEWER, 30 IN. STORM DRAIN, 10 IN. SANITARY SEWER, ELECTRIC DUCTS, (2) MASSACHUSETTS AVENUE - 20 IN. X 24 IN. COMBINED SEWER, 8 IN. WATERLINE AND ELECTRIC DUCTS.	THE FOLLOWING UTILITIES WILL BE RELOCATED: 8 IN., 20 IN., 24 IN. AND 30 IN. WATERLINES, 4 IN., 12 IN. AND 24 IN. GAS LINE, 12 INC. SEWER AND ELECTRIC DUCTS.	THE FOLLOWING UTILITIES ARE TO BE RELOCATED: (1) PUTNAM SQUARE AREA: 24 IN., 12 IN., AND 10 IN. WATERLINES, 8 IN. AND 12 IN. GAS LINES, 15 IN. AND 14 IN. BY 15 IN. SEWER, ELECTRICAL AND TELEPHONE DUCTS; (2) BRATTLE STREET (SQUARE) AREA: 10 IN. WATERLINE, 8 IN. GAS LINE, 10 IN. AND 12 IN. BY 16 IN. SEWER, ELECTRICAL AND TELEPHONE DUCTS.	THE FOLLOWING UTILITIES ARE TO BE RELOCATED IN THE PUTNAM SQUARE AREA: 24 IN., 12 IN. AND 10 IN. WATERLINES, 8 IN. AND 12 IN. GAS LINES, 15 IN. AND 14 IN. X 15 IN. SEWER, ELECTRICAL AND TELEPHONE DUCTS.

EXHIBIT M-2

HARVARD SQUARE AREA ALTERNATIVES SUMMARY OF IMPACTS

Massachusetts Bay Transportation Authority

SHORT TERM (CONSTRUCTION)	LINE A	LINE D-1 (D-2) PROJECT	LINE G-1	LINE G-2
B. CONSTRUCTION METHODS				
1. CUT-AND-COVER	CUT-AND-COVER WORK WILL BE DONE IN 3 AREAS: (1) MT. AUBURN ST. FROM BRATTLE SQ. TO STORY ST.; (2) NORTH SIDE OF MASS. AVE. BETWEEN LINDEN ST. AND HOLYOKE ST.	CUT-AND-COVER TUNNEL ALONG MASSACHUSETTS AVE. AND PEABODY ST. FROM HOLYOKE ST. TO COMMON AND ALSO AREAS AROUND HARVARD SQ. BETWEEN HARVARD COOP AND LEHMAN HALL. D-2 FLAGSTAFF PARK AREA.	CUT-AND-COVER TUNNEL IN TWO AREAS: (1) FROM PUTNAM SQ. TO MIDWAY BETWEEN ATHENS AND BANKS STREETS ON MT. AUBURN ST., (2) BRATTLE STREET FROM BRATTLE SQUARE TO STORY STREET ALONG BRATTLE STREET.	CUT-AND-COVER TUNNEL FROM PUTNAM SQUARE TO MIDWAY BETWEEN ATHENS AND BANKS STREETS ON MT. AUBURN ST.
2. TUNNELING	DEEP-BORE WILL EXTEND FROM STORY ST. TO PORTER SQ. ACCESS SHAFT AT STORY ST. AND MT. AUBURN ST.	DEEP-BORE TUNNEL FROM THE COMMON AT HEMENWAY GYM TO PORTER SQ. STATION. CONSTRUCTION ACCESS SHAFT LOCATED AT THE PORTER SQ. STATION.	DEEP-BORE TUNNEL FROM ATHENS-BANKS STREET ALONG MT. AUBURN ST. TO BRATTLE SQUARE WITH AN ACCESS SHAFT AT ATHENS-BANKS ST. AND FROM STORY ST. ON BRATTLE ST. TO PORTER SQ. STATION. CONSTRUCTION ACCESS SHAFT LOCATED AT THE PORTER SQ. STATION.	DEEP-BORE TUNNEL FROM ATHENS-BANKS STREET TO PORTER SQUARE STATION. ACCESS CONSTRUCTION SHAFTS LOCATED AT ATHENS AND BANKS ST., CHURCH ST. GARAGE, AND PORTER SQUARE STATION.
3. LENGTH OF CONSTRUCTION	RAPID TRANSIT TUNNELS--22 MONTHS ASSUMING CONCURRENT WORK IN VARIOUS AREAS. STATION REVISIONS--8 MONTHS. NO BUSWAY WORK IS REQUIRED.	RAPID TRANSIT TUNNELS - 20 MONTHS ASSUMING CONCURRENT WORK IN VARIOUS AREAS. NEW STATION - 20 MONTHS. REVISIONS TO BUS TUNNEL - 6 MONTHS. (D-2) RAPID TRANSIT TUNNELS - 28 MONTHS; NEW STATION - 28 MONTHS; NEW BUS TUNNEL - 12 MONTHS.	RAPID TRANSIT TUNNELS - 24 MONTHS ASSUMING CONCURRENT WORK IN VARIOUS AREAS. NEW STATION - 18 MONTHS. MINOR REVISIONS TO BUS TUNNEL - 3 MONTHS.	RAPID TRANSIT TUNNELS - 24 MONTHS ASSUMING CONCURRENT WORK IN VARIOUS AREAS. NEW STATION - 18 MONTHS. MINOR REVISION TO BUS TUNNEL - 3 MONTHS.
4. CONSTRUCTION DIFFICULTY	NOT AS DIFFICULT AS LINE G-1; MORE DIFFICULT THAN D-1 OR D-2. DIFFICULTY CREATED BY TUNNELING UNDER BUILDINGS.	LEAST DIFFICULT TO CONSTRUCT BECAUSE OF PREDOMINANCE OF CUT-AND-COVER WORK.	NOT AS DIFFICULT AS LINE G-2; MORE DIFFICULT THAN LINE A. TUNNEL UNDER AND ADJACENT BUILDINGS, TUNNEL PROFILE PARTLY IN ROCK, PARTLY IN SOIL PRODUCING AN UNDESIRABLE MIXED-FACE TUNNELING SITUATION.	THE MOST DIFFICULT TO CONSTRUCT. TUNNELING UNDER AND ADJACENT BUILDINGS; TUNNEL PROFILE PARTLY IN ROCK, PARTLY IN SOIL PRODUCING AN UNDESIRABLE MIXED-FACE TUNNELING SITUATION; LARGE DIAMETER TUNNELING SHIELD REQUIRED FOR STATION TUNNELS.
PROJECT COSTS				
A. TOTAL CONSTRUCTION COSTS	$44,000,000	D-1 $32,000,000 D-2 $35,000,000	$74,000,000	$79,000,000
B. OPERATION COSTS DURING CONSTRUCTION	$89,000	$121,000	$34,000	$34,000
C. INCREMENTAL OPERATIONS COSTS PER YEAR	$146,000	$163,000	$136,000	$139,000
CONTRACTURAL REQUIREMENTS				
A. BUS TUNNEL CONNECTING MASS. AVENUE AND MT. AUBURN ST.	EXISTING BUS TUNNEL REMAINS.	EXISTING BUS TUNNEL REMAINS.	EXISTING BUS TUNNEL REMAINS.	EXISTING BUS TUNNEL REMAINS.
B. MAINTAIN PRESENT LEVEL OF TRANSIT SERVICE DURING CONSTRUCTION	SERVICE MAINTAINED WITH MINOR INTERFERENCE.	SERVICE MAINTAINED TO A DEGREE. SOME BUS LINES TO BE REROUTED TO OTHER TRANSIT STATIONS. TEMPORARY TRANSIT STATION WILL CAUSE SOME INCONVENIENCE TO PASSENGERS. BUS STOPS ON MASSACHUSETTS AVE. NEAR HARVARD YARD ELIMINATED.	SERVICE MAINTAINED WITH MINOR INTERFERENCE.	SERVICE MAINTAINED WITH MINOR INTERFERENCE.
C. PROVIDE ACCESS FROM BRATTLE SQUARE TO STATION	NO ACCESS FROM BRATTLE SQUARE.	CAN BE PROVIDED IN ABANDONED EXISTING TUNNEL.	STATION ENTRANCE IN BRATTLE SQUARE.	CAN BE PROVIDED IN ABANDONED EXISTING TUNNEL.
D. AVOID SEVERE SURFACE DISRUPTION DURING CONSTRUCTION	DISRUPTION MINIMIZED THROUGH USE OF TRAFFIC REROUTINGS, DECKING-OVER OF EXCAVATIONS, PARKING RESTRICTIONS.	SAME AS A	SAME AS A	SAME AS A
E. TURNBACK & STORAGE FACILITIES	EXISTING FACILITIES MAINTAINED.	ABANDONED TUNNEL COULD BE USED.	PORTIONS OF ABANDONED TUNNEL COULD BE USED.	PORTIONS OF ABANDONED TUNNEL COULD BE USED.

EXHIBIT M-3

UNITED STATES GOVERNMENT

Memorandum

DEPARTMENT OF TRANSPORTATION
URBAN MASS TRANSPORTATION ADMINISTRATION

DATE:

In reply refer to:

APR 21 1977

SUBJECT: On-site Inspection of Harvard Square, Boston, Massachusetts,13 April 1977

FROM : Environmental Program Specialist

TO : File

On April 13, 1977, an on-site inspection of Harvard Square and consultation was held per a request by the Advisory Council on Historic Preservation (ACHP) in accordance with §800.5(b) of their procedures. In attendence were Sharon Conway(ACHP), Elizabeth Amadon and Margo Webber(Massachusetts Historical Commission), Jack Leary, Charles Steward, Mel Naseck, and Donna Garofano(MBTA), Charles Sullivan, Allison Crump, Robert Neily and Charles Elliot(Cambridge Historical Commission), Supratik Bowes (Harvard University), Peter Hopkinson and Ted Tsoi (Skidmore, Owings and Merrill), Jerry Angell(DeLeuw Cather), Dominic D'eramo(Sverdrup and Parcel) and Peter Benjamin, Joe Clougherty, Kiyoshi Mano and myself(UMTA).

We gathered at 10:00 a.m. at the Kiosk in Harvard Square to inspect the site of the proposed Red Line project and the effect it will have on National Register properties. We examined the Kiosk, Flagstaff Park, and Old Harvard Yard especially the Johnston Gate, all within the Cambridge Common Historic District. Peter Hopkinson, the architect with SOM, conducted the inspection. He discussed alternative station entrance plans, landscaping, restoration of existing sites and probable construction impacts and mitigation. Later we met at SOM to discuss the alternatives and proposals for inclusion in the Memorandum of Agreement to mitigate the adverse effects.

The Kiosk will be dismantled, stored and reused. A number of options exist including use as a newstand or as a shelter for the escalators leading into the station. The exact location is undetermined as yet but it will be placed near its current site. The CHC and SHPO will review all final plans. Johnston's Gate will not be disturbed but part of the wall will be removed temporarily for slurry walls and will be restored to its original form when construction is completed.

EXHIBIT N

A new proposal for Flagstaff Park was raised by Charles Sullivan of the CHC. This involves removing a wall constructed in 1909 from the National Register property. The SHPO's office concurs with this proposal but since this is a new design the Advisory Council must review it. Sharon indicated it would take about 2 weeks for them to decide if removal of the wall and/or moving the location of a statue would be satisfactory. Mr. Sullivan indicated the wall was a visual intrusion on the historic original Cambridge Common. UMTA requested that this issue be resolved and the decision incorporated into the Memorandum of Agreement. All parties are amenable to an Agreement which uses the draft prepared by the MBTA as a basis with the addition of some data for noise and vibration suppression which is contained in the preliminary case report. The MBTA will provide us with 2 options for inclusion in the Agreement. Option A will temporarily remove the wall in Flagstaff Park and replace it after construction, option B will remove it permanently. The agreement will only be concerned with National Register properties in Harvard Square.

The Arlington Town Center District, also a National Register property, is not adjacent to nor abutting the station entrance. We feel a determination of "no effect" can be made with concurrence by the SHPO. We requested a survey be conducted, if needed, to locate any properties which may be eligible for nomination to the Register. The CHC and the SHPO feel that a thorough survey has been conducted in Cambridge and no additional eligible properties should surface. While the alignment from Cambridge to Arlington has been surveyed,a thorough review of the properties should be conducted to prevent last minute nominations. The MBTA & SHPO plan to meet with the Arlington Historical Commission to discuss historic properties and effects.

The MBTA will be revising the proposals for the Agreement. The Advisory Council will be making a decision about removing the wall in Flagstaff park in approximately two weeks. They will advise us of the decision to be incorporated into the Agreement. The final design of the Kiosk and Flagstaff Park

will remain open with a condition included for reviews and approval by the SHPO and CHC. The MBTA will send us their proposals which we will forward to the Advisory Council for inclusion in the Agreement which they will prepare (per §800.5(g) of their Procedures).

Sue Kaminsky

Sue Kaminsky

Attachments:

MBTA Draft of Agreement
CHC Review

COPY

The Commonwealth of Massachusetts
Office of the Secretary
Massachusetts Historical Commission
Secretary of the Commonwealth
294 Washington Street Boston, Massachusetts 02108
(617) 727-8470

May 17, 1977

Mr. Peter Benjamin
Director, Office of Program Analysis
Urban Mass Transportation Administration
400 7th Street, SW
Washington, D.C. 20590

Re: Red Line Extension
Cambridge and Arlington, Massachusetts

Dear Mr. Benjamin:

As a follow-up to our April 13, 1977 meeting with representatives of your office, the Advisory Council on Historic Preservation, and the project proponents, and after further consultation with the Cambridge Historical Commission and the Arlington Historical Commission as agreed upon at that time, we have the following comments.

After careful review of the proposed project, I, as State Historic Preservation Officer in Massachusetts, feel that the Cambridge portion of the project will have no adverse effect on any above-ground properties listed or eligible for the National Register of Historic Places. To insure that there will not be adversity, the Massachusetts Historical Commission and the Cambridge Historical Commission must be provided further review of the Harvard Square portion, including location and preservation of the Harvard Square Kiosk, design of the square, above-ground subway and news stand structures, signage and street furniture, and design/redesign of Flagstaff Park.

For the Arlington section of the project, we feel that there will be no effect on historic properties listed or eligible for the National Register. Since the subway entrance at Arlington Center is adjacent to the Arlington Town Center National Register District, both the Massachusetts Historical Commission and the Arlington Historical Commission request review of the subway entrance at this location.

EXHIBIT O

May 17, 1977
Mr. Peter Benjamin

As discussed in our April 13 meeting, the Memorandum of Agreement for this project should include the issues outlined in the Draft Memorandum prepared by the MBTA in consultation with the MHC (see attached).

These comments do not pertain to archeological resources, which will have to be considered separately at a later date. Please contact us if we can be of further assistance as UMTA carries out its responsibilities under 36 CFR 800.

Sincerely yours,

Elizabeth Reed Amadon

Elizabeth Reed Amadon
Executive Director
Massachusetts Historical Commission
State Historic Preservation Officer

xc: Sue Kaminsky, UMTA
Charles Steward, MBTA

ERA/MBW/etd

Chapter III

HARVARD SQUARE AREA

Chapter III

HARVARD SQUARE AREA

The Harvard Square area of Cambridge has no one defined boundary. The geographic area discussed in this section extends eastward to Putnam Square, northward to about Waterhouse Street, southward to the MBTA yards, and westward to Radcliffe College. This general locale will be referred to as the "Harvard Square Area". The intersection of Massachusetts Avenue, Boylston Street and Brattle Street--where the entrance kiosk to the existing Harvard Square Station is located-- is specifically "Harvard Square". Distinguishing features of the Harvard Square Area are shown on Figure III-1.

Problems associated with extending the Red Line beyond the Harvard Square Area have been the subject of many studies over the years. The recent BTPR Study did not explore multiple options for achieving a northward heading in and through the Harvard Square Area, but used a single premise as the basis for engineering analysis, described thus: "For the benefit of these studies, it was assumed that the Harvard Square Station would remain in its present location and the construction costs include a modernization of the station in addition to extending the present platforms to handle six car trains. This assumption will not preclude further studies at a later date to determine the most suitable station design or location." Subsequently, the BTPR assumption (referred to as Line A in this chapter) was studied along with several other alternatives. By consensus of the community, a different concept, designated "Line D-2", was selected. Community responses which led to the selection of this alternative are included in Appendix F.

As the D-2 concept was the premise around which environmental issues related to the Harvard Square Area were addressed, engineering and construction considerations of this concept are described in detail in this chapter.

The physical facilities and operations of the existing subway and bus service in Harvard Square were intrinsic elements in all the design options studied. The need to maintain transit service during construction of the extension imposed significant constraints on design solutions.

RED LINE FACILITIES

The Red Line terminal station in Harvard Square has been in existence since the line was constructed in 1912. The subway from Central Square in Cambridge approaches the Harvard Square Area in a single tunnel under Massachusetts Avenue. West of Putnam Square the tracks begin to separate vertically, and arrive at the station platforms (between Dunster and Holyoke Streets) on two levels in separate tunnels. Outbound trains enter the upper level and when reversed beyond the station, re-enter via the lower, inbound tunnel. Passenger platforms are one above the other, both on the Harvard Yard side of the tracks. From the station the tracks again converge to a common level in a three-track 45-foot-wide tunnel extending under Brattle Street and Brattle Square to Eliot Street where the open train yard begins. Cross-over and lay-over capabilities are provided in the tunnel and yards.

The station complex features a system of trolley-bus tunnels also operating at two levels. A two-way ramp descends from Mount Auburn Street to a tunnel portal near Brattle Square, then separates on two levels in tunnels paralleling the transit tunnel. At Harvard Square bus tunnels turn northward, converge to a common level and ascend to the surface on an incline in Flagstaff Park. Passenger loading/unloading areas are under Harvard Square. Southbound trolleys use the lower level, and northbound trolleys, the upper level. Portions of several buildings on Brattle Street are supported by the roof of the bus-trolley tunnels.

Intermodal transfer is accomplished by a number of ramped passageways connecting each rapid transit platform with each of the two bus levels. The passageways, fare collection lobby, and access stairs to the surface are tightly concentrated in the area directly under Harvard Square. At the surface, the transit facility is distinguished primarily by the entrance kiosk in the center of the Square.

A description of the station was published in MBTA's "Manual of Guidelines and Standards", December 1966 and appear below. Numbers in parentheses refer to numbers on Figures III-3 and III-4.

"Harvard is the terminal station of the Cambridge or western section of the Red Line. In traffic volume, among Red Line stations, it is second only to Washington because it handles heavy bus transfer to and from North Cambridge, Arlington, Belmont, and Watertown. The station is a complex network of levels, ingeniously connected to each other by ramps (1), and the underground transfer circulation in particular works extremely well. Exiting traffic to the Square above (including transfer to buses at grade) is not so well handled, and suffers from inadequate escalators. Entrance to the busway levels from the street is currently confusing due to unnecessarily awkward routing at the mezzanine level. The underground complex and the kiosk above are both very handsome structures suffering primarily from clutter, poor lighting, and poor signing. There is inadequate shelter for bus passengers at grade (2) and confusion with surface traffic.

Circulation

Entrance and Fare Collection - The major entrance to the station occurs at the kiosk in Harvard Square (3). Stairs at the kiosk lead to an intermediate mezzanine level, where several decisions are made (4). One may go to the upper (northbound) busway by turning right, reversing direction and using another stair; one may go to the lower (westbound) busway by turning right, reversing direction and using a ramp (5); or one may go to the inbound (departing) train platform by continuing straight ahead down a flight of stairs (6). A secondary stair entrance, (not open to the public) is located on Massachusetts Avenue at Holyoke Street, and leads through a small fare collection area to the eastern end of the inbound (departing) train platform (7).

Transfer - Transfer circulation from the busways to the inbound (departing) platform is via two ramps, one up and one down, which lead to the fare collection area (8). Transferring from outbound (arriving) trains to the busways is via two other ramps which lead from the platform (9) to the busways.

Exit - Exit circulation is exactly the reversal of the entrance circulation route with the addition of an escalator to the surface from the upper busway and with the addition of two exit stairs leading from the arriving platform to the Yard (north) side of Massachusetts Avenue (10). "

The station as related to streets and buildings is illustrated by plan (Figure III-5) and by cross-sections. (Figure III-6). Views of the Kiosk and interior areas are shown on Figures III-7 and III-8.

Existing bus and trackless trolley operations, both below and on the surface are described in the Section "Traffic and Transportation".

PROJECT DESCRIPTION

Line Segment

The extension would commence at the present two-level Harvard Square Station. In order to retain the existing bus-rapid transit-tunnel arrangement and maintain the extension on public right-of-way, it is proposed that the two-level concept be retained throughout the new transit station and its connection to the existing tracks.

From Holyoke Street, tracks in separate tunnels would turn north on a 250-foot-radius curve into Massachusetts Avenue, then enter a new station platform area extending 440 feet from about Church Street to Flagstaff Park. From the station, tracks would proceed northerly on a slight "S" curve to about Cambridge Street, continuing northerly in tunnel/deep bore under Massachusetts Avenue. The alignment immediately north of Harvard Square Station is discussed in detail in Chapter IV.

The upper level track through the present Harvard Square Station platform area is approximately 25 feet below the ground surface; the lower level track is 40 feet below ground. Throughout

the connecting tunnels and new station platform area, the 15-foot vertical distance between tracks would be maintained. Tracks would descend at a 3.6 percent grade to depths of 32 feet and 47 feet, respectively, below ground at the beginning of the new station platforms. Through the platform area, tracks would continue to descend on a grade of less than 0.5 percent. The horizontal alignment of tracks and platforms would curve slightly northwest on a 4,000-foot radius.

The alignment and profiles are shown on Figure II-1B.

To accommodate new transit platforms and the transit extension on the proposed alignment, the north legs of the trolley-bus tunnels would be relocated westerly from about Church Street to the portal at Flagstaff Park. The bus ramp would remain in its present location.

Station

The proposed Harvard Square Station complex is a composite of new station construction and elements of the existing station, subways and busways. In concept, it is a rotation of the two existing track and platform levels from the present east-west position under Massachusetts Avenue to a north-south position--with the area under Harvard Square remaining the focal point for primary access, underground intermodal connections and fare collection functions. The space under the Square would be entirely restructured to conform with the new design requirements. The abandoned train tunnel in the Harvard Square to Brattle Square sector would be kept structurally intact and those portions utilized in the new station concept would be internally renovated. Bus tunnels not rebuilt would also be renovated.

Primary access points from the surface to the station would be in Harvard Square. Additional access could be afforded from the south and the north. Final selection of entrance locations would be coordinated with on-going studies of pedestrian and vehicular circulation by the City of Cambridge. The objective of these studies is to create a better pedestrian environment by lessening conflicts and congestion and by an allocation of open space more favorable to pedestrians.

The station site plan (Figure III-2) incorporates one of the surface concepts under consideration by the City. In this concept the present kioskisland would be expanded southward to the sidewalk between Boylston and Dunster Streets, eliminating the present east-west trafficway south of the kiosk. Brattle Street from Harvard Square to Brattle Square would be narrowed to two travel lanes, and Boylston Street would operate two-way. Under another concept being considered by the City, Brattle Street would be closed to vehicular traffic entirely and be developed as a pedestrian walkway. Based on either of these plans a principal entrance would be built in the area south of the present kiosk. In Brattle Square, an entrance would lead to the existing train tunnel which would be developed as a passageway to the lobby area under Harvard Square.

The City of Cambridge and Harvard University have expressed interest in having access capability near Church Street. A secondary mezzanine is proposed which would connect an entrance at the corner of Church Street and Massachusetts Avenue with an entrance near Harvard University's Straus Hall and would also function as an entrance to the rapid transit platforms.

Egress to the north end of the station platforms would be necessary for emergency use. Therefore, an inconspicuous emergency exitway is planned at the south end of the Flagstaff Park near the busway incline.

Figures III-2 and III-9 also indicate a possible entrance near the Harvard Trust Company on the west side of Massachusetts Avenue and one in front of Harvard University's Lehman Hall. It is questionable whether or not the latter two entrances are necessary or desirable, but the option would be explored in pre-grant design phases.

An agreement has been made between the MBTA and the Massachusetts and Cambridge Historical Commissions to retain the existing kiosk structure as a prominent element in the Harvard Square area. During the pre-grant engineering phase, consultation among the parties will be held for the purpose of reviewing plans for the retention and reuse of the kiosk.

Escalators and stairs would link the principal entrance in the kiosk area with the fare collection lobby. Stairs would also link the Brattle Square entrance with the bus tunnel. Within the station, all levels would be linked with ramps. (Figure III-9). Escalators and internal ramps would facilitate access to bus loading areas and rapid transit platforms for the ambulant handicapped.

For the non-ambulant handicapped, an elevator would be furnished. Several alternative locations are possible. There is adequate sidewalk space in the proposed kiosk plaza shown in Figure III-2. If elevator use were limited solely to the handicapped, a visually compatible entrance in the headhouse would be appropriate.

The fare collection lobby would be at an elevation approximately midway between the upper and lower transit platform levels and would serve both levels from a single fare collection line. After passing through the turnstyles, passengers travelling north would ascend a ramp to the upper platform; inbound passengers would descend by ramp to the lower platform.

Platforms would follow a slight (4,000-foot-radius) horizontal curve and slope northward on a descending grade of less than 0.5 percent. Minimum platform widths would be about 18 feet. In contrast to the existing station, the upper track would not be directly above the lower platform--eliminating a difficult acoustical problem.

Ramps would also connect the "free" area of the fare collection lobby with the two trolley-bus loading platforms. Distance from train to bus would approximately equal the present distance and circulation would be simpler and more clearly delineated.

The functional characteristics of the underground busways would not change but passenger boarding areas would be modified. Bus passenger areas would be upgraded in appearance, consistent with adjacent new construction.

Air relief shafts would be required at both ends of the proposed Harvard Square Station. The shaft at the south of the station would open into Massachusetts Avenue Right-of-Way near Dunster Street. At the north end of the station, a similar shaft would open into Flagstaff Park. A wall might be required to enclose the opening and raise the interface of the air stream above the ground level of the park.

Right-of-Way

The project would be within public right-of-way except in two locations where land taking or permanent easements would be required for sub-surface construction. Both parcels are owned by Harvard University. They include a strip of land along the fence line at Lehman Hall and possibly a small area near Straus Hall for

the Harvard Gate entrance. The affected properties, comprising yard space and formal fencing, would be restored following construction. Existing subway exits inside the University's fence line at Lehman Hall and at Wadsworth House could be eliminated, with use of the space reverting to the University.

Additional takings or easements would be necessary near Gannet House in order to ease the merging of Cambridge Street traffic on to Massachusetts Avenue.

Construction Methods

Cut-and-cover methods would be used to construct the project from the point of track tie-in to a point in Massachusetts Avenue near Cambridge Street (opposite the Hemenway Gym) where sufficient depth would be reached for tunnel/deep bore construction. Project elements in the cut-and-cover section include transit tunnels, the new platform area, a temporary station, and the relocated section of bus tunnels.

Construction would be phased to minimize traffic disruption. Carefully phased decking procedures would permit near-normal traffic operation while construction proceeds below the decking.

Where excavation passes near Lehman Hall, a slurry wall would be constructed. The need to underpin this and other nearby buildings in the project area is considered unlikely.

Relocation of the north legs of the bus tunnels would necessitate on-street operation of buses and trolleys. It is recommended that on-street operation be modified, but that it continue for the duration of the construction period. This would free tunnels and ramps for use in moving equipment and materials into and out of the construction site and would measurable lessen the impact of construction in the Harvard Square Area.

Construction of this section of the project would require approximately 36 months and would involve three phases:

Phase I

a. A temporary transit station will be constructed on the opposite side of the tracks from the existing platforms. An auxiliary passenger stop would also be developed in the MBTA yards. See Temporary Stations, following.

b. Passenger operations would be transferred to the temporary stations, and the present platforms, mezzanines, passageways and kiosk entry would be abandoned. Train tunnels would remain in use.

c. Busway operations in tunnels would be discontinued and interim surface operations instituted.

Phase II

The new station, new tunnels, and the relocated section of busways would be constructed.

Phase III

a. The tie-in with existing tracks would be made, and transit operations would commence at the new station.

b. Portions of the abandoned train tunnels would be redeveloped as future concessions.

c. All final interior and surface construction would be completed.

Temporary Stations

The temporary station in Harvard Square would be constructed between Dunster and Holyoke Streets under the south side of Massachusetts Avenue. It would mirror the present station and consist of an upper, outbound platform and a lower, inbound platform. Existing tunnel walls at both levels would be opened to the extent required for access to and from the transit cars. The width between the existing tunnels and the south curbline of Massachusetts Avenue would be adequate for station construction. Fare collection facilities would be located in a temporary head house on the surface. Paid passengers would descend by stair directly from the head house to the lower, inbound platform. Outbound, (terminating) passengers would ascend to the surface via separate stairways. The existing subway entrance near Holyoke Street, presently unused, would be used as an auxilliary exit element and possibly also for entry, pending further investigation of its functional adaptability.

The east-west trafficway between Boylston and Dunster Streets would be shifted northward, and the vacated space, would be used for the temporary head house and pedestrian circulation. The street area over the temporary station would be decked and restored to normal traffic use.

A second temporary transit passenger area would be provided in the MBTA train yard immediately beyond the Eliot Street tunnel portal. This station would be in close proximity to the trackless trolley turn-around at the Harvard Motor Inn area of Mount Auburn Street and could thus serve the relatively large numbers of transit passengers who transfer to the Watertown and Waverly trackless trolleys. If implemented, the passenger load at the Harvard Square temporary station would be substantially

less, and the transferring passengers would avoid the walk from Mount Auburn Street to Harvard Square. The station itself would be a simple surface platform and accessible from an enclosed fare collection facility.

The locations of both temporary stations are shown on Figure III-11.

Cost

Estimated construction costs of the new Harvard Square Station transitways and busways are tabulated in Table III-1. The work estimated begins at the existing Harvard Square Station near Dunster Street and extends to the interface with tunnel/deep bore construction near Hemenway Gym. Included is the cost of relocating the north bus tunnel. The costs do not include project wide items such as floating slabs, trackwork, ventilation, electrification, signalization and communications. For these costs, see Chapter II. The estimate is based on midpoint of construction dollars.

Table III-1

ESTIMATED CONSTRUCTION COSTS
HARVARD SQUARE AREA
(Does not include project wide items)

MAC Code	Description	Amount	
15.11.10	Station Structure	$42,636,000	
15.13.10.12	Utility Relocation	882,000	
15.10.00	Demolition	310,000	
15.13.00	Protection & Repair of Existing Structures	265,000	
			$44,093,000
15.06.10	Right-of-Way	180,000	
31.00.00	Relocation	58,000	
			238,000
15.08.01	Professional Services	3,087,000	
15.15.02	Field Inspection	1,362,000	
15.15.02	Force Account	882,000	
15.16.00	Project Administration	2,757,000	
			8,088,000

Table III-1 (continued)

	Subtotal	$52,419,000
32.00.00	Contingencies	4,409,000
	Total	$56,828,000

ALTERNATIVES

Five alignments and station locations were investigated during the course of the present study. Designations (Lines A, D-1, D-2, G-1 and G-2) were adapted from earlier rapid transit studies. The general alignments of the various alternatives are shown on Figure III-12.

Prior to the selection of the preferred alignment, an informational brochure was distributed to the Harvard Square community. Summaries of each line's impacts were tabulated in the brochure and are included in this report. (Figures III-13, III-13A and III-13B). Community support for the different alternatives is summarized in Table III-2. Sources of these comments are included in the Appendix.

Selected Line D-2 has been described in detail in all other sections of this chapter. The following is a description of the alternatives to Line D-2.

Alternative Line A

The new subway on Line A would join existing tracks in tunnel under Brattle Square and curve to Mount Auburn Street on a descending grade to reach a depth suitable for bored tunneling. From about Story Street, the subway proceeds northerly in tunnel/deep bore under Hilliard, Brattle, and Garden Street; then northwesterly under the Cambridge Common to Massachusetts Avenue.

The existing station would remain. Transit platforms would be lengthened eastward under Massachusetts Avenue for a distance of about 160 feet, and the station would be refurbished in a manner consistent with current MBTA station modernization programs. Station entrances would remain substantially at their present locations. The underground busways would not be affected by the subway extension.

TABLE III-2

SUMMARY OF COMMENTS RECEIVED ON PROPOSED
ALTERNATIVES FOR HARVARD SQUARE RED LINE EXTENSION

Organizations/groups/agencies	Line (s) Supported	Comments
Cambridge Transportation Forum	D-2	D-2 alignment supported because "...can be built the soonest and has best chance of funding." G alignments considered too expensive.
Neighborhood Ten Association	D-1, D-2	D alignments supported because alignments are "...in the public way, will require minimal land-taking or easements...and construction phase can be begun the most quickly." G alignments opposed because station is shifted closer to Brattle Square. Line A unacceptable because line would travel under houses.
Cambridge Civic Association	A, D-1, D-2	A supported because of minimal surface construction disruption. D alignments supported if disruption minimized to greatest extent. G alignments too costly.
Mid-Cambridge Neighborhood Association	D-2	D-2 supported because of its lower cost and location under public way. Benefits of G-1, G-2 not felt to outweigh additional costs.
Planning for People	D-2	D-2 considered to provide best potential bus/rapid transit interface. G lines' high costs not outweighed by advantages of Brattle Square station location.
Owner of following Harvard Sq. area properties: 1-8, 17-41A, 0-24, 28-36 Brattle St.; 0-24 Boylston Street; 99 Mt. Auburn Street.	D-1, D-2	D alignments supported because they "...appear to have the least impact on existing historic, residential and retail areas." Other alternatives considered too expensive.
Cambridge Historical Commission	D-2	D-2 supported because it remains in public right-of-way removed from sensitive sites. D-1 considered to be too close to sensitive sites.

Organizations/groups/agencies	Line (s) Supported	Comments
Harvard Square Development Task Force	D-1, D-2	D alignments supported because of their compatibility with the Harvard Square Comprehensive Policy Plan and widespread support of various segments of the community.
Community Development Department	D-1, D-2	The D alignments were recommended as the "...best long-term and short-term choice for Cambridge." G lines opposed because advantages do not outweigh added cost.
Hilliard Street Residents	D-1, D-2	D alignments supported because of low cost, station location, and construction under public right-of-way. Line A opposed because of construction under Hilliard St. homes. G lines opposed because station would be located too near residential areas.
Harvard University	G-1, G-2	G alignments supported because they are considered to be less disruptive during construction, and the station location in Brattle Sq. considered desirable in long-range. D alignments too disruptive during construction and maintenance of HSQ station.
Chamber of Commerce	G-1, G-2	G alignments recommended because they offer "...an opportunity to relocate a station in a more logical position concerning specific population density, ridership, and future economic development." Chamber has indicated it would support Line D if selected.
Harvard Square Business Association	D-1, D-2	D alignments favored because they would be under public right-of-way, and in the long-term "...unique shops and retail stores will be preserved without fear of displacement and economic development of the Harvard Square business district can proceed on an orderly basis."

Individuals/agencies	Line (s) Supported	Comments
City Councillor Duehay	D-1, D-2	D alignments supported because of potential east/west bus transfer station location nearest large employment area, and alignment beneath public right-of-way. Other alternatives too costly.
Sarah and Wolfe Wolfinsohn 11½ Hilliard Street	D-1, D-2	D alignments supported because line travels under the public right-of-way, and costs the least. Line A opposed because of need to tunnel under private property. G alignments opposed because Brattle Sq. station would be too close to residential area.
Brett Donham	A	Line A supported because there would be minimal construction disruption and present station would be maintained. G alignments opposed on basis of cost.
Cynthia Smith 1619 Mass. Ave.	D-1, D-2	D lines supported because of station location and construction within public right-of-way.
Enid Fales 11 Hilliard Street	D-1, D-2	D lines supported because of station location and construction within public right-of-way. Line A opposed because of construction under Hilliard St. houses.
Cambridge City Council	D-1, D-2	See resolution, adopted April 7, 1975 at Cambridge City Council Meeting (Supplemental Data Volume).
Red Line Working Committee	D-1, D-2	See resolution, adopted April 24, 1975 at meeting of Red Line Working Committee (Supplemental Data Volume).

Land taking would be required at 129 Mount Auburn Street for a construction shaft, and permanent easements would be required from 15 properties between Mount Auburn Street and the Cambridge Common. Tunnel construction would be by deep bore methods except for a section of cut-and-cover construction in Mount Auburn Street. Underpinning would be necessary to protect such major structures as the Loeb Drama Center, Schlesinger Library, Fay Hall, and Byerly Hall. The need to underpin several minor structures (mostly wood frame) is considered questionable. Extending the station platform would also involve cut-and-cover construction on the north side of Massachusetts Avenue between Linden and Holyoke Streets.

It is estimated that construction of Line A would require approximately 22 months, at a cost of $44,000,000.

Line A Advantages

Construction on Line A would offer the following advantages:

- Transit and bus service could be maintained with only minor interferences.
- Transit turn-back, lay-up and train storage capabilities could be furnished in the existing tunnel.
- Surface disruptions would have comparatively moderate impacts.
- Station activity would remain at the focal point of the Harvard Square community.

Line A Disadvantages

Construction on Line A would have these disadvantages:

- Construction would occur under and adjacent to a residential area.
- A commercial building, housing 14 businesses and 90 jobs, would be displaced.

- The subway would underpass Fay House and Byerly Hall, both within the Cambridge Common Historic District/National Register of Historic Places.

- Extensive noise and vibration control measures would be necessary.

- There would be virtually no opportunity to modify entrance locations or to furnish station access in Brattle Square.

The A corridor was not selected, principally because the subway would pass under a residential area, and would displace several businesses. Community reaction to Line A was strongly unfavorable.

Alternative D-1

This alignment is a variation of the selected (D-2) alignment with the platform area and north tunnel link in Peabody Street approximately parallel to Harvard Yard. While the station and subway on this alignment would not conflict with both existing bus tunnels, the geometrics beyond the station would be less desirable than those on the D-2 alignment since transit tunnels would curve more sharply to enter Massachusetts Avenue. All other features and environmental considerations would be similar to those described for Line D-2 in this Chapter.

Line D-1 Advantages

Construction on Line D-1 would offer the following advantages:

- It would not be necessary to relocate north legs of both trolley-bus tunnels. It would be necessary, however, to reconstruct one section of the upper tunnel.

- Construction under Flagstaff Park, a part of the Cambridge Common Historical District, would be avoided.

Line D-1 Disadvantages

Disadvantages would include:

- More severe curves north of the station.
- Construction near several Harvard University dormitories, increasing the extent of building protection work required.
- Greater traffic disruption, due to the long reach of cut-and-cover construction on Peabody and Cambridge Streets.

Line D-1 was dropped from further consideration primarily to achieve the better transit alignment offered in Line D-2.

Alternative G-1

The subway on Line G-1 would extend westerly from the existing subway at Putnam Square near Ellery Street, underpass Mount Auburn Street and Brattle Square to a new station under Brattle Street, and continue northerly under Radcliffe Yard and Cambridge Common to Massachusetts Avenue. The station in Brattle Street and the tunnel from the tie-in point to a construction shaft on Mount Auburn Street near Athens Street would be cut-and-cover. Remaining tunnel construction would be deep bore.

The southern end of the new transit station would begin at the point where the deep bore tubes pass under the existing train and bus tunnels at Brattle Square; the northern end would be at Story Street. The station would have a center platform about 40 feet below street level, end-loaded from a fare collection area below the Brattle Square area. The entire width of Brattle Street, building line to building line, would be required for station construction. The existing underground busways would be retained, but internally modified so that the boarding areas are shifted somewhat closer to Brattle Square. The existing train tunnels from Harvard Square to Brattle Square would be renovated to serve as a wide pedestrian passageway linking the new transit station with the bus loading areas near Palmer

Street as well as entrances along Brattle Street and in Harvard Square.

The principal entrance from the surface would be in Brattle Square and would connect directly with a new mezzanine fare collection area overlooking the platform level. An exit or a combined entrance-exit would be needed at the north end of the station.

No property takings would be required. It would be necessary to obtain easements from 24 properties. Underpinning would be required for at least 16 major buildings. Several structures of historical significance are on or near the alignment.

It is estimated that construction on Line G-1 would require 24 months and cost $74,000,000.

Line G-1 Advantages

Line G-1 would offer the following advantages:

- The extension could be constructed with minimal disruption of existing transit and underground busway operations.

- Redirection of the transit line to Mount Auburn Street at Putnam Square would avoid constraints, due to the rapid transit tunnel, against possible use of street right-of-way in Harvard Square and Massachusetts Avenue for vertical separation of vehicular and pedestrian traffic. However, there are other physical and technical constraints that make vertical separation questionable.

- Relocation of the Harvard Square station in Brattle Square is seen by proponents of transit in a G-Corridor as more compatible with retail, business and pedestrian activity. (Opposing views are summarized under "Line G-1 Disadvantages.")

- This location would place the fewest constraints on conceptual development and overall quality of station design.

Line G-1 Disadvantages

- The line would cross under or near several buildings where the type of use and occupancy is particularly sensitive to sources of noise and vibration. These include St. Paul's Church, Brattle Theater area, Loeb Drama Center, Radcliffe Yard buildings, Gutman Library and Epworth Church. At such locations extensive noise and vibration controls would be necessary.

- Numerous historical properties registered in national and/or local listings would be along the path of the subway or this alignment. The subway would pass under Fay House and Byerly Hall and adjacent to such sites as the William Brattle House, the Village Blacksmith, St. Paul's Church, Lampoon Building and Longfellow Hall. These sites would also involve special consideration in regard to possible structural stress, noise and vibration.

- Pedestrian access to about 20 stores will be hindered by decking and construction operations along Brattle Street. Similarly, access to a number of apartment houses, businesses and residences will be made difficult at decked-over excavations near Putnam Square.

- The subway on this alignment would be costly to construct due to long reaches of new tunnel construction, extensive underpinning, and special construction to control noise and vibration.

- It will be difficult to route surface buses close to the station entrances either because of the existing street pattern or the City's proposals to develop a pedestrian walkway in the Brattle Square area.

- The station location in Brattle Square would tend to increase development pressure in the Brattle Square area; opponents fear that the character of the retail sector would be adversely affected.

Alternative G-2

New subway on Line G-2 would tie in with the existing Red Line at Putnam Square, continue westerly under Mount Auburn Street to Dunster Street, curve northerly to a new station under Palmer Street, then underpass the Old Burying Ground and the Cambridge Commons to Massachusetts Avenue at Chauncy Street.

This alternative was developed to take advantage of the tunnel/deep bore concept in Mount Auburn Street and to underpass the Harvard Square Area in a long, flat curve to a direct northward heading. In terms of overall transit geometry, this alignment would be the best of all alternatives considered.

The station at Palmer Street would be constructed by bored tunneling methods and would consist of two separate large-diameter tunnels with a small cross gallery at about mid-point connecting the inbound-outbound platforms. A construction shaft would be necessary to drive the station tunnels; this shaft could be located north of Church Street in the area of the Church Street Garage and its adjacent open parking lot.

The principal entrance would be off-street at the corner of Palmer and Brattle Streets on property now occupied by the Zum Zum restaurant. The abandoned train tunnel in Brattle Street would be redeveloped as a pedestrianway to Harvard Square and for intermodal transfer to buses. The existing busways would remain but a new bus loading area would be developed on the upper bus level at about the same location as the existing lower level loading area.

Easements would be required from 31 properties. Relocation of the restaurant and Church Street Garage would be required. At least ten major structures would require under-

pinning. Historic sites on or near the alignment include the Old Burying Ground, Christ Church, St. Paul's Church, Lampoon Building, and 26 Church Street.

The extension on the G-2 alignment would require about 24 months to construct and cost about $79,000,000.

Line G-2 Advantages

Construction on Line G-2 would offer these advantages:

- Transit and bus service could be maintained with minimal interference.
- Abandonment of transit operations in Massachusetts Avenue west of Putnam Square and in Harvard Square would permit use of right-of-way for possible grade separation of vehicular and pedestrian traffic. However, there are other physical and technical constraints that make vertical separation questionable.
- The main entrance to the relocated station would be in the principal retail section of the Harvard Square Area.

Line G-2 Disadvantages

- The subway on Line G-2 would be the most costly to construct, due to the protection work required for major buildings, the additional shaft and large diameter shield needed to construct the station by deep bore methods, and costs of extensive tunneling through mixed-face materials.
- The alignment passes under or near several historic sites and buildings. Considerable concern has been voiced in regard to the line passing under Christ Church.
- Parking in the commercial area is most severely affected by this line which would require removing the Church Street Garage.

The primary reasons for not selecting either Line G alternative were high construction costs and potential impacts on historical buildings.

No-Build Alternative

Harvard Square is the hub of the Cambridge street system and of an extensive radial transit system. The complicated radial street pattern and high volumes of vehicular and pedestrian movements have produced exceedingly difficult circulation problems in and around Harvard Square. One of the more pertinent local issues to be evaluated under the no-build alternative is the congestion problem.

Public transportation is both affected by, and a contributor to, the congestion. In describing the radial transit system at the Red Line terminus in Harvard Square, the BTPR Red Book points out that "Harvard Square is unsuitable as the key interchange point because of its poor road accessibility for buses, being one of the most congested points in the Northwest. Concord Avenue and Mount Auburn Street are poorly suited for carrying heavy volumes of bus traffic as they are narrow streets with heavy traffic volumes that lead into the congested Harvard Square intersection. Massachusetts Avenue, while a wide street, is poorly suited for the heavy volume of bus traffic because of heavy traffic volumes and problem congestion points at Porter Square and Harvard Square. Radial bus service on Massachusetts Avenue and Concord Avenue is further inadequate because, despite the frequency of service, buses on those streets are usually filled in the suburban communities or by North Cambridge residents filling buses before Porter Square, and offer only highly overcrowded service for Cambridge residents. While rapid transit is quite good from Harvard to Boston, the termination of the line in a poorly accessible spot fed by overcrowded buses on congested streets, severely limits its usefulness for serving radial travel through the Cambridge radial corridor. Parking by transit users at Cambridge stations severely overstresses limited parking availability for local residents and businesses."

If the Red Line is extended, the most visible benefit will be the reduction in the number of buses entering the Harvard Square area during rush hours. The number of buses arriving hourly would decrease from 136 to 79, and this alone would help alleviate some of the traffic and circulation problems. If the Red Line were not extended, there is no apparent alternative which would relieve the pressure of existing transit operations in Harvard

Square; further, as long as the area's streets continue to be saturated, transit service from this point could not be substantially improved.

The existing transit station and underground busways, though visually confusing, function well. Presumably the station would be eventually modernized if the Red Line were not extended. While there are obvious ways to enhance the interior spaces of the station--such as renewed finishes, lighting and graphics--the tightly organized system of ramps and stairs and the constraints of existing train and bus tunnels would not allow major changes such as relocating entrance/exit points in conjunction with street changes and improvements in pedestrian circulation proposed on the surface. Underground pedestrian connections to Brattle Square would be impossible to implement because the tunnel space from Harvard Square to Eliot Street would be used entirely for train turn-back operations. The roofs of upper level train and bus tunnels are close to the street surface and lower level tunnels are quite deep. In combination, the tunnels preclude the possibility of passageways over or under the system connecting the station with new entrance points on either the south or west sides of Harvard Square. In essence, the existing access locations are locked-in.

The location of the kiosk would not preclude the possibility of putting into effect the street plan used as a basis for the street-level scheme shown for the project; that is, two-way traffic would be permitted on Boylston Street, traffic on Brattle Street limited to two travel lanes, and the present kiosk area extended to the south sidewalk.

With the kiosk in its present location, however, the sidewalk space at the head of the stairway is narrow and often overcrowded. Any widening of the trafficway between the kiosk and the west sidewalk would further narrow the pedestrian space and jeopardize pedestrian safety.

In summary, the no-build alternative would retain and perpetuate existing conditions and transit service with little opportunity to contribute to an improved surface environment. The principal advantage is that Harvard Square would not be subjected to disruption due to construction of the project.

TRAFFIC AND TRANSPORTATION

Existing Conditions

Street System

Twelve urban roadways converge at Harvard Square. Nearly 60,000 vehicles enter the area each weekday over 15 travel lanes. Bypass routes are circuitous, discontinuous and unattractive.

Street routings, traffic controls and parking restrictions are shown in Figure III-14. With the exception of Massachusetts Avenue north of Cambridge Common and the Cambridge Street Underpass, streets are undivided with parking permitted on one or both sides. Left-turn conflicts are minimal because of various one-way routings:

- Flagstaff Park is the hub of a counterclockwise traffic circle for all Massachusetts Avenue-Garden Street-Cambridge Street turning movements.

- Traffic circulates around Harvard Yard in a clock-wise direction on Peabody, Cambridge, and Quincy Streets and Massachusetts Avenue.

- Massachusetts Avenue operates westbound from Putnam Square to the kiosk area, serving as half of a one-way couplet with Mount Auburn Street westbound between Eliot Square and Putnam Square.

- Quincy Street (southbound), Peabody Street (northbound), Brattle Street (south and westbound), and Eliot Street (southbound) are the other major one-way roadways in the Square.

Most key intersections are signalized. Pedestrians cross alternate travelways during successive vehicle phases of the cycle. "All Walk" displays are provided at mid-block only at pedestrian actuated signal locations. A coordinated traffic signal system aids progressive flow along Boylston Street and Massachusetts Avenue. Commercial vehicle restriction on Memorial Drive results in diversion of Central Square-to-Watertown truck traffic on Mount Auburn Street.

Traffic Volumes

Average 1974 daily trafic volumes for the major through streets are listed in Table III-3. The only grade-separated roadway in the vicinity, the Cambridge Street underpass, experiences the highest daily volume, 32,000 vehicles. Cambridge Street is a collector for crosstown travel, distributing traffic between Kirkland Street, Cambridge Street, and Broadway to the east and Massachusetts Avenue, Boylston Street, and Garden Street to the west of Flagstaff Park.

Peabody Street, bounding Flagstaff Park on the east, serves both the Flagstaff Park traffic circle and traffic circling Harvard Yard. This is the major weaving section of the Square with 29,000 vehicles per day passing through this street segment. Another weaving section, Brattle Street between Harvard Square and Brattle Square, carries 26,000 vehicles per day. Massachusetts Avenue and Boylston, Garden and Mount Auburn Streets are the other heavily traveled roads in the Harvard Square Area with volumes exceeding 15,000 per day.

Table III-3

AVERAGE 1974 DAILY TRAFFIC VOLUMES AND TRAVEL LANES

Harvard Square, Cambridge
Red Line Extension

Street	Between	Volume (Vehicles)	Number of Travel Lanes
Memorial Drive	De Wolfe and Boylston Streets	33,000	4
Cambridge Street	(at underpass)	32,000	6
Peabody Street	Garden Street to Cambridge Street	29,000	5
Massachusetts Avenue	Cambridge and Waterhouse Streets	26,000	4
Brattle Street	Boylston Street to Brattle Square	26,000	3
Boylston Street	Memorial Drive and Eliot Street	21,000	3
Garden Street	Mason Street and Massachusetts Avenue	20,000	4
Massachusetts Avenue	Quincy Street to Brattle Street	18,000	3
Garden Street	Concord Avenue and Mason Street	16,000	2
Mount Auburn Street	Boylston Street to De Wolfe Street	15,000	2

Source: Cambridge Traffic Commission and Wilbur Smith & Associates Field Observations, October and November 1974.

Peak Period Volumes

During the morning peak, southbound Massachusetts Avenue and eastbound Garden Street, Cambridge Street, and Brattle Street traffic volumes are somewhat higher than opposing volumes. This indicates that principal work destinations are east and south of Harvard Square.

The major morning peak hour volumes in vehicles per hour (vph) are:

Garden Street eastbound - 900 vph
Cambridge Street eastbound - 1,400 vph
Massachusetts Avenue southbound - 900 vph
Brattle Street - 1,600 vph

The evening peak hour volumes are directionally balanced, except for Massachusetts Avenue north of Cambridge Common. Major peak-hour volumes are:

Massachusetts Avenue northbound - 1,200 vph
Peabody Street - 1,900 vph
Brattle Street - 1,800 vph
Boylston Street - 1,100 vph

Vehicle Queues

Queuing at intersections reflects capacity deficiencies, and discontinuities. Queue lengths were observed during the 4 to 6 p.m. weekday period. All three approaches to the three-phase Mason Street-Garden Street intersection exhibited substantial queues. Backups were also observed at the Flagstaff Park traffic circle, expecially on the northbound approach to Massachusetts Avenue from Peabody Street.

All six approach lanes at the Harvard Square intersection exhibited measurable queues, with that on the Boylston Street northbound approach the longest.

Public Transport

Each weekday more than 52,000 riders arrive at Harvard Square via public transit. About 28,500 arrive by the 13 MBTA bus routes serving the area and 24,000 by rapid rail transit.

Of 13 bus routes serving Harvard Square, all but one--Route 86 Union Square--terminate at Harvard Square. Riders using four trackless trolley routes (71 Watertown, 72 Huron Avenue, 73 Waverly and 77 North Cambridge) and two diesel bus routes (77A Arlington Heights and 96 Medford) board and alight in the Harvard Square Station bus tunnel. The other six routes stop on the surface, primarily at designated locations along the northbound curb lane of Massachusetts Avenue and Peabody Street between Holyoke Center and Flagstaff Park.

Patronage is greatest for routes serving areas north and west of Harvard Square. As shown in Table III-4, Route 77A Arlington Heights transports 5,600 riders daily to the Square. Other heavily used routes are 77 North Cambridge, with 4,500 riders; 73 Waverly, with 4,250; and 71 Watertown, with 3,500. As might be anticipated, routes paralleling existing Red Line service have the lowest daily patronage.

Bus activity is very pronounced during peak periods. Massachusetts Avenue experiences the heaviest bus volumes with 112 scheduled bus trips in the peak-hour. Buses from Arlmont, Park Circle, and Belmont approach on Garden Street and loop clockwise around Harvard Yard. Only the Lechmere inbound and the Union Square bus use westbound Cambridge Street through the underpass. Mount Auburn Street, west of Eliot Square, carries a scheduled 60 buses per hour between the west tunnel portal. At each tunnel portal about 144 vehicles enter or exit in the peak-hour. Since the location of doors on diesel buses preclude passenger loading on westbound trips through the tunnel, these buses exit and circle the Treadway Inn to re-enter the tunnel from Mount Auburn Street. Trackless trolleys, with doors on both sides, can load and unload in one trip. However, the Route 71 Watertown vehicles loop clockwise around the Cambridge Common during weekday rush hours to re-enter the tunnel and return to Watertown.

Table III-4

1974 BUS PASSENGER VOLUME ENTERING HARVARD CORDON
TYPICAL WEEKDAY
Harvard Square
Cambridge Red Line Extension

LINE			DAILY VOLUME	A.M. PEAK		
Number	Name	Street	Persons	Persons	Buses	Average Per Bus
1	Dudley	Massachusetts Ave. (E)	3,250	200(1)	12	16(1)
69	Lechmere	Cambridge	300	100(2)	6	16(2)
71	Watertown	Mount Auburn	3,500	500	10	50
72	Huron	Concord	900	250	6	63
73	Waverly	Mount Auburn	4,250	1,340	20	67
77	North Cambridge	Massachusetts Ave. (N)	4,500	1,200	20	60
74	Belmont	Concord	1,500	285	6	48
75	Kendall	Broadway	100(2)	40(2)	3	13(2)
77A	Arlington Heights	Massachusetts Ave. (N)	5,600	1,440	30	48
78	Park Circle	Concord	1,100	275	6	46
84	Arlmont	Concord	1,250	375	8	47
86(S)	Allston	Boylston	300(2)	90(2)	3	30(2)
86(N)	Somerville	Kirkland	300(2)	90(2)	3	30(2)
96	Medford	Massachusetts Ave. (N)	1,650	310	6	52
		TOTAL	28,500	6,495	139	586

(1) 500 outbound toward Massachusetts Institute of Technology in a. m. peak.
(2) Estimated from volumes at distant checkpoints. All volumes expanded from 7:00 a. m. to 11:00 p. m. counts to 24-hour totals.

SOURCE: MBTA Schedule Department, Traffic Count Summary and Line Statistics, 1973 - 1974.

Buses and trolleys use the tunnel layover in the Bennett Street Yard behind the Treadway Motor Inn. Buses on six surface routes terminating at the Harvard Square Station layover (occasionally two abreast in the evening peak period) at their boarding locations near the kiosk.

Between 22,000 and 25,000 riders board the Red Line daily at Harvard Square Station. This is the busiest MBTA station outside the Boston central area. It is estimated that more than half--13,400-- arrive via a tunnel vehicle and about 11,400 enter the station from the surface. See Table III-5. An additional 8,200 riders enter the station to board a tunnel bus or trackless trolley. Of the total 19,600 persons entering the station daily, approximately 12,900 arrive on foot from the Harvard Square environs, 1,500 are auto passengers, 400 park-and-ride, and about 4,400 arrive by surface bus.

Pedestrian Activity

Major pedestrian corridors in Harvard Square are:

- Quincy Street from Cambridge Street to Mount Auburn Street;
- Massachusetts Avenue from Cambridge Common to Brattle Street; and
- Brattle Street from Harvard Square to Church Street.

Important pedestrian crossings are located at:

- Massachusetts Avenue near the Information Center at Holyoke Street and at Harvard Street;
- Garden Street at Mason Street;
- Waterhouse Street at Concord Avenue;
- Garden Street at Concord Avenue;
- Arrow Street at De Wolfe Street;

Table III-5

ESTIMATED HARVARD SQUARE STATION TRANSIT BOARDERS

Typical Weekday, 1975
Cambridge, Massachusetts

ARRIVAL MODE	DEPARTURE MODE		
	Red Line (Persons)	Tunnel Bus (Persons)	Total (Persons)
Local walk-in	6,600	6,300	12,900
Auto drop-off	1,200	300	1,500
Parked autos	300	100	400
Other	300	100	400
Surface bus	3,000	1,400	4,400
Total from surface	11,400	8,200	19,600
Tunnel Bus	13,400	1,000	14,400
TOTAL	24,800	9,200	34,000

SOURCE: Based on "How to Get Out of Harvard Square on A Train", Cambridge Department of Planning and Development, 1974, and Wilbur Smith and Associates survey of Route 77A riders, January 8th, 1975.

- Boylston Street at Memorial Drive, at Mount Auburn Street, and at Brattle Street;

- Mount Auburn Street at Dunster, Holyoke, Plympton and De Wolfe Streets; and,

- Putnam (Sullivan) Square.

Travel Desires

A cordon study conducted by Cambridge Department of Planning and Development in 1972 identified major through, local, and Cambridge auto trips in Harvard Square. During the 12-hour period from 6 a.m. to 6 p.m. 57,689 vehicles crossed the cordon into Harvard Square. About 44 percent (25,379) had either an origin or destination in the Square. Trips with either origin or destination in Cambridge (other than Harvard Square) accounted for an additional 46 percent of the total trips. Only 10 percent of the total vehicle trips were non-Cambridge-oriented through trips.

In assessing potential traffic disruption during project construction, it is deemed essential to temporarily reroute traffic not destined for Harvard Square. While travelers to the Square are expected to adjust to construction detours or short-term congestion on a day-to-day basis, other drivers may elect to use streets in residential areas to avoid construction disruption if alternative routes are not defined.

Twenty high-volume vehicle movements through Harvard Square were identified. These movements accounted for 15,488 trips daily, or 48 percent of the 32,310 auto trips through the Square not destined for the Harvard Square Area. The highest volume, 2,444 trips occurred on Massachusetts Avenue from north of Cambridge Common to Putnam Square. Northbound Boylston Street to Massachusetts Avenue north of the Common was the second highest, with 1,678 trips. The volume of through trips from Concord-Garden Street to Cambridge Street was third highest, with 1,599 trips. The 634 auto trips from Massachusetts Avenue near Cambridge Common to Garden-Concord Street intersection was twentieth highest.

Construction Disruption

Disruption to surface travel caused by construction of the project would be limited to Massachusetts Avenue from Holyoke Center to Cambridge Common at the Cambridge Street signalized intersection. Preliminary investigations of possible construction methods and staging procedures indicate that existing traffic movements can be maintained through Harvard Square during construction. A formal detour plan to divert traffic onto other streets will not be required.

Techniques under consideration include the following:

(1) The installation of temporary decking, incrementally, and in carefully phased sequences. The geometry of travel lanes would be slightly varied from sequence to sequence.

(2) Construction of permanent decking using a modified "Milan Method". The method is similar to that shown on Figure II-8 except that the tunnel roof is emplaced close to grade level and the traffic surface is restored directly thereafter. Staging strategies and intermittent manipulation of traffic lanes would also be necessary in this instance.

Parking Impacts

Subway construction, street improvements, and interim bus berthing locations will reduce the available parking supply during construction. Displacements will not occur simultaneously nor for the same length of time. The locations and possible spaces affected include:

Flagstaff Park	35
Gen. MacArthur Square	21
Garden Street	15
Eliot Square	48
Brattle Street	16
Dunster Street	3
Massachusetts Avenue (near Holyoke Street)	2

Bus Circulation During Construction

Trackless trolleys will be unable to continue through Harvard Square during bus tunnel reconstruction and realignment. It is recommended that trackless trolley service between Watertown-Waverly and Harvard Square (Routes 71 and 73) loop clockwise around the Harvard Motor Inn and connect with Red Line service at the Eliot Yard temporary station. This provision would approximate existing service to Routes 71 and 73 transit riders. The direct mode change would relieve the area of about 8,000 new pedestrian-trips daily along Brattle Street between the Harvard Motor Inn and the kiosk.

Trackless trolley service along Massachusetts Avenue (Route 77 North Cambridge) should loop clockwise around Cambridge Common. Boarding and layover areas should be provided along westbound Garden Street curb at the Common. Buses should be permitted to turn left from Waterhouse Street to northbound Massachusetts Avenue. The Huron Avenue trackless trolley (Route 72) should also loop around the Common and load in the same area as Route 77 trolleys.

The Route 77A Arlington Heights Buses should be routed to the Eliot Street temporary station via Harvard Square and Brattle Street. Southbound these buses would also provide transfer service from the Cambridge Common area for those passengers desiring connections with rapid transit or trolley routes at Eliot Street. Returning buses would loop counterclockwise on Eliot and Boylston Streets to Harvard Square and proceed northbound on Massachusetts Avenue.

Route 96 Medford buses, southbound, should also proceed to the Eliot Street Station. These buses would then provide northbound shuttle service from Eliot Street to bus loading areas on Garden Street before proceeding northward.

Surface buses oriented toward the northwest via Concord Avenue (Routes 74, 78, and 84) should board along eastbound Garden Street curb just west of Massachusetts Avenue. Outbound buses would loop counterclockwise around Flagstaff Park and continue out Garden Street.

Route 1 (Dudley), 69 (Lechmere), and 75 (Kendall) surface buses should layover along Massachusetts Avenue opposite Plympton Street, just east of the construction disruption area. The one through bus serving the area, Route 86 Union Square, could stop on Church Street on the southbound trip and near the kiosk on the northbound trip. Layover space in Harvard Square is not required for this bus route.

Reduced Station Ridership

The Central Transportation Planning Staff estimates that the 1980 Preliminary Patronage Forecast for Harvard Square Station Inbound is as follows regardless of terminus:

Peak Hour Boardings - 2,984
24 Hour Boardings - 11,093

The peak hour boardings are further subdivided as follows:

Origin	Total Pk. Hr. Boardings	Walk-In	Bus	Kiss-and-Ride	Parking
Mid-Cambridge	1,674	980	694	0	0
North Cambridge	150	20	100	30	0
Watertown	630	0	630	0	0
E. Belmont	530	0	530	0	0
Total	2,984	1,000	1,954	30	0

Reduced Feeder Bus Requirements

The following compares hourly arrivals (arrivals in a one-hour period) during peak hours at proposed Harvard Square for the existing, minimum and maximum bus supply strategies.

Hourly Vehicle Arrivals for the Weekday Rush Hour*
7-9 a.m. and 4-6 p.m.
at Harvard Square Station

	Existing	Minimum	Maximum
Harvard	136	91	91
Trolleys	56	56	56
Buses	80	35	35

The following compares hourly arrivals during peak hours at proposed Harvard Square station for the three supplies and distinguishes between arrivals on routes terminating at the station and arrivals on "through routes" serving the station and not terminating at the station area.

Bus and Trolley Arrivals During a Given Hour
Within the Weekday Rush Hour*
at Harvard Square Station

Terminal Routes	Existing	Minimum	Maximum
Harvard	130	85	85
Through Routes			
Harvard	6	6	6

* Source: MBTA

LAND USE

Existing Conditions

Policies and guidelines for the future development of the Harvard Square Area have been proposed in a series of recommendations published in preliminary draft form (December 1974) under the title, "The Harvard Square Comprehensive Policy Plan". The recommendations were prepared by the Subcommittee on Policy Planning of the Harvard Square Development Task Force, and the City of Cambridge Department of Community Development. The purpose of the Policy Plan is to achieve a consensus among the major interest groups in the Harvard Square Area on goals and objectives for the area. When agreement on basic goals is attained and the Comprehensive Policy Plan is adopted, proposals will be formulated to implement the policies, and to identify specific actions required by the city, MBTA, the business community, and private groups.

In general, the policy statements are directed toward preserving the unique character of the Harvard Square Area and to effect guidelines which will insure that these qualities are enhanced rather than destroyed.

The main areas of policy in which the Red Line extension will play a sensitive role are:

1. The recommendation to "preserve the kiosk area as a means of orientation and as a place in which activity can be concentrated."

2. Recommendations to maintain a compact commercial core and establish limits on the extent and type of future commercial development.

3. Recommendations to develop a surface environment in the commercial areas wherein pedestrian activity will predominate.

Of major significance in determining the impacts of relocating the rapid transit station is the proposed placement

of station entrances and exits. The points of access to a transit station are important because it is around these locations that pedestrian activity is most concentrated. Levels of pedestrian activity and distance from station access points influence patterns of development, land use, and property values.

The existing Red Line and the extension on a D-2 alignment have station locations in Harvard Square.

In a study conducted for the City of Cambridge, Monacelli Associates pointed out that Harvard Square has served as the focus of development for the City since the 17th century. The focus of the Harvard Square community is the immediate area surrounding the kiosk entrance to the existing station. Since the early 1900's, the transit station has reinforced this focus. Presently about 20,000 people enter the transit facilities from the surface daily. This volume contributes significantly to the intense level of pedestrian activity which exists in Harvard Square. That the kiosk area serves as the community focal point is also substantiated by the increase in property values as one approaches the kiosk area.

Line D-2 would maintain primary entrances and exits in the immediate vicinity of the kiosk. The number of people entering the station daily from the surface is not expected to change significantly. While there would be changes in the pattern of pedestrian traffic, these changes would reflect a reduction in pedestrian-vehicular conflict rather than less intense activity. Because the primary access points would remain in close proximity to the kiosk area, development patterns would not be expected to change. There might tend to be an increase in property values in the Harvard Square area due to the effects of extending the Red Line beyond Harvard Square but these increases would follow the existing property value pattern (i.e. increase as one approaches the kiosk). Also, the areas adjacent to the new station entrances/exits (Harvard Yard, Harvard Coop block and Cambridge Common) are fully developed. In a technical report prepared for the Cambridge Redevelopment Authority in 1968, Robert Gladstone and Associates stated:

"Where existing development within areas immediately adjacent to a transit station is relatively permanent, and therefore not available for development, little or no impact is to be expected."

Among the several recommendations of the Comprehensive Policy Plan to improve the pedestrian environment, three will indirectly involve the subway. These are:

1. A system of open spaces which will provide a network for pedestrian movement within the commercial areas and between the commercial area and the surrounding four sectors of the Harvard Square Area. A salient element of the network is a main pedestrian axis. The Policy Plan states:

   "An important pedestrianway, from which at least all automobile traffic should be excluded, should be developed along Brattle Street and Eliot Street leading from the kiosk area to the southwest sector. (Unless an alternative service and loading system can be developed, it may be necessary to permit trucks for loading purposes on part of the pedestrianway during selected hours.) In addition to functioning as a pedestrianway, the main pedestrian axis should serve as the main organizing element for land use in the commercial area."

2. Separation of vehicular and pedestrian trafficways. The Plan states:

   "To the maximum extent possible, vehicular traffic--particularly heavy volumes of through movements--should be separated horizontally from the pedestrian network in the commercial core, i.e. assigned to different routes. The pedestrian network should be maintained essentially at grade level, due to the absence of sufficient densities of people or development to justify vertical separation. Underpasses or overpasses are not generally anticipated, but should be considered in a few cases to accommodate specific conditions, to capitalize on unique

opportunities or to provide access to public transportation. Second level connectors, skyways, subsurface arcades and the like are not seen as part of the vocabulary of new development in the commercial core, except for special circumstances."

3. Public regulation of open space. The recommendation states:

"A program should be developed for the design and coordination of all elements of the streetscape (lighting, signs, paving, canopies, trash receptacles, mail boxes, seating areas, kiosks, outdoor merchandise displays etc.). Guidelines and review for the private sector should be established in order to create a more enjoyable pedestrian environment and controls for the public sector should be instituted in order to improve the appearance of the area."

The significance of these policies in relation to the proposed subway extension is the interdependence of surface development (i.e. changes of traffic and street patterns) and the location and design of the subway's exit-entrance elements. Concepts to achieve, in some measure, the goals of the Policy Plan in regard to improving the pedestrian environment are currently under review by the City. These studies have to do with potential changes of traffic patterns to reduce the number of conflicting movements in the kiosk area and to reduce or eliminate the concentration of moving and standing vehicles in the proposed pedestrian axis. It is anticipated that the options will be narrowed in the near future.

The existing subway system and the locked-in access at the kiosk is a major constraint against changes of traffic patterns at the surface, and of itself has contributed significantly to the present vehicular-pedestrian conflicts. The D-2 alignment permits considerably more flexibility as to the number and location of access points and hence is much more adaptable to surface changes. These potentials are discussed in the Project Description.

Impacts

Property Takings

Property takings are not required by the D-2 alignment. Easements must be obtained for subsurface construction and are described in the Project Description. As indicated, the easements occur under restorable open spaces and do not involve displacements of buildings, businesses or persons.

Property takings would be necessary if an off-street location is selected for a station access element--for example, an entrance near Straus Hall.

Displacements at Harvard Square would be limited to one business - the out-of-town newsstand located adjacent to the existing Harvard Square kiosk. During construction this business could be relocated in the temporary station and then moved to the new station once it opens.

Commercial Activities

The number of shoppers and patterns of shopping directly attributable to or influenced by the existence of public transportation will not be appreciably affected, in the long term, by the relocation of subsurface elements of the station. The geographic focus of the station would be unchanged and, therefore, retail display and sales areas will retain the exposure that exists today. The convenience of subway transportation, when extended to communities north of Harvard Square, may induce more persons to travel to the area for shopping.

During construction of the subway, stores on the west and south sides of the kiosk area may be affected by a ban on parking. Sidewalks in front of retail stores would not be disrupted.

Joint Development

Within MBTA right-of-way, the existing train tunnels from the Harvard Square kiosk area to the portal at Eliot Street would no longer be required for train operations. The segment from the kiosk to Brattle Square, or at least portions of this space, will be needed for pedestrian circulation and for new bus passenger

loading areas. The space is large, however, and part of the area could be allocated for commercial use.

The remaining segment of tunnel from Brattle Square to Eliot Street would serve no planned transit function. It is conceivable that development in the southwest sector, especially in the former area of the train yards, may justify the use of the tunnel for additional subsurface commercial activity.

It is also possible that subsurface connections could be made with adjoining buildings. In general, this is physically feasible only with buildings on the south side of the transit complex from the kiosk to Mount Auburn Street.

The floor of the tunnel is about one story deeper than the basement levels of existing buildings on the south side and any connections made would involve considerably more construction than merely penetrating existing tunnel walls for communicating access.

The existing two-level bus tunnels prevent the development of direct pedestrian communication with subsurface levels of buildings on the north or west sides of the station area.

A unique opportunity would be presented by the surplus of subsurface space in conjunction with captive pedestrian activity induced by the transit facility. No specific proposals have been introduced to define the extent or type of development, if any, that would utilize the space and hence matters of economic feasibility, development costs, allocation of costs, and legal considerations have not been investigated. Several technical problems would need to be explored to ascertain the feasibility of development--such as utility services, ventilation, air conditioning, fire safety, security, housekeeping, maintenance,

movement of retail commodities, and so forth. Potential negative impacts, both below the surface and above, would have to be evaluated. Major structural modifications could impose significant short-term impacts.

Outside MBTA right-of-way, for several years, the City has been interested in improving the usability of public open spaces and traffic conditions in the Cambridge Common-Flagstaff Park area. Various concepts are currently being explored by the City to consolidate the Common and Flagstaff acreages as one--a concept dependent upon traffic solutions which would eliminate the section of Massachusetts Avenue now bisecting the two park areas. One of the traffic options relating to the concept is a highway bypass tunnel connecting Garden Street with the Cambridge Street underpass. Preliminary alignment and profile studies explored in conjunction with those of the D-Line indicate that a highway tunnel could be developed that would not conflict with the proposed transit and busway tunnels.

If the highway tunnel and/or other options prove feasible, and are implemented either concurrently with the subway extension or at a future time, new joint development strategies may be in order. These could include coordination of bus and trolley circulation, bus stops, and station access as appropriate to the overall improvements expected to be achieved by the concept.

Urban Design

At surface level, the subway extension will be visually evident only at the various entrances.

The present entrance kiosk is a familiar landmark of Harvard Square, and has sentimental significance to some residents and former residents of the area. Its setting is also characterized by an adjacent, popularly used newstand, considerable visual clutter of signs, poles and other appurtenances, and the ever-present congestion of vehicles and pedestrians in

and around the kiosk island. A second, less active, entrance-exit element is accessible from the sidewalk fronting Lehman Hall at Harvard Yard and is inconspicuously located behind Harvard's fencing.

These entrances except the kiosk would not be functionally compatible with the design requirements of the new station and would be replaced, within the same general area, by elements of similar scale and order of prominence.

The preliminary concepts depicted in this chapter indicate a major entrance slightly south of the present kiosk and secondary entrances at Church Street and near Straus Hall. New to the present streetscape would be a possible additional entrance at Brattle Square. The architectural character of access openings at street level have not been determined in this stage of design development, nor have the exact locations been pinpointed. City policies with regard to the existing street system as well as design elements such as landscaping, paving and street furnishings will influence final design solutions and will require further coordination.

SOCIO-ECONOMIC FACTORS

The following information appears in: Volume 2; Social and Economic Characteristics, Planning and Development Department, City of Cambridge, May 1974.

Existing Conditions

Rental Markets

"During the past ten years the large, multi-unit structure has become increasingly dominant. In 1970, 70.9 percent of the total units in the Harvard Square area were of this type (five or more units). In 1960 the percentage was 63.3 percent of the total." (p.21)

"The City is a major rental market partially due to the presence of the several colleges; and home ownership in 1970 accounted for only ten percent of the housing in the Square and 20 percent in the City." (p. 22) "There has been an 11.1 percent decline in owner-occupied units over the past 20 years." (p. 22)

"Harvard Square remains one of the highest priced residential areas in the City. Over the 20 year period rents have increased three-fold in Harvard Square and the value of sales in housing has more than doubled." (p. 22)

"Housing units in the Harvard Square Area generally rent at a substantially higher level than units elsewhere in the City. There was a $10 differential in 1950, a $23 gap in 1960 and by 1970 the difference had amounted to $41. In 1970, the median contract rent in the Harvard Square Area was $160 per month, in Cambridge $119 per month. (Table 25)" (p. 23)

"The median contract rent in the Harvard Square Area has gone up at a higher rate than has that for the City in the past 20 years. The notion that Harvard Square is the focal point of Cambridge and one of the focal points of the Boston region may have contributed to the high price of living in and near the Square. In addition, the limited number of rentable units as compared with the City's, coupled with an increasing demand by the expanding college and young professional age groups tend to push rents upward. Moreover, Harvard University gives credence to the fact that students and University related personnel have stimulated rents upward due to their ability to group together, thus pooling their incomes to pay a higher rent than a normal family can afford."

Commercial/Retail Rental Markets

"Rents have been escalating upwards beyond $10 towards rates of $12 and $14 per square foot of floor space per year. The pattern has been that after formerly low-rent retail space has been purchased and modernized, the new rent levels exceed the old by a wide margin. These new rates then tend to be reflected in the lease renewal rates of other properties... Such rent levels make it increasingly difficult for the small, family-oriented retailer to survive. Since the turnover rate of goods and profit

margins must increase to pay the new rents, the small family oriented merchants and others who are operating marginal enterprises may very often be moved aside by retailers with more of a flair and with more select, higher priced goods which cater to more sophisticated buyers. Or the smaller, more leisurely shops might be replaced in some cases by the lower-cost, lower-quality, high-volume type of chain retailer..." (p. 29)

Retail Sales

"The Square's market is partially regional and its clientele are geographically dispersed as well as locally 'captive'." (Captive market refers to those customers in a retail market area who are present there for other primary reasons such as employment, business transactions, attendance at school or because they live there. They patronize the retail facilities because they are a convenience.) "These diverse elements would include the university community, persons employed elsewhere in Harvard Square, tourists and visitors to Boston and Cambridge, persons changing modes of transportation at the MBTA station, residents of the immediate surrounding neighborhoods of Cambridge or of nearby suburbs to whom Harvard Square is the most accessible shopping location, and persons residing farther out in the Boston region who come to Harvard Square to find goods either unavailable elsewhere or not in the same concentration."

"There are obvious difficulties in attempting to determine accurately the composition of such a mix of customers. Various methods were utilized including parking studies (place of residence of persons parking at curbside and in parking lots by trip purpose); traffic studies (origins of persons entering Harvard Square by automobile to shop); personal interviews conducted with shoppers; and interviews with store owners and managers. These several studies are summarized below:"

"Gavin Study: A sample interview of Harvard Square shoppers was conducted in May of 1971 by Angus Gavin, a Harvard University graduate student in Urban Design. His study revealed that approximately 30 percent of the shoppers interviewed arrived in the Square by car, and 70 percent by other modes. The highest incidence of arrival by automobile (51 percent) was by customers of Design Research, and the lowest (22 percent) by customers of

Woolworth's and RIX. Overall, the largest percentage of shoppers arrived by foot (39 percent); i.e., walk-in trade, so that it can be assumed that most of the shoppers arriving other than by car are either part of the Harvard Square 'captive market' or are residents of Cambridge and nearby communities conveniently accessible by public transportation." Table III-6 illustrates the modal split of the Harvard Square shoppers questioned.

Table III-6

PERCENT OF HARVARD SQUARE SHOPPERS
AT SELECTED STORES 1971

By Mode of Arrival (Gavin Study)

Destination	Auto (Percent)	Subway (Percent)	Bus/ Trolley (Percent)	Foot (Percent)	Other (Percent)
Design Research	51	8	10	13	18
TRUC	38	14	6	34	8
Touraine's	30	8	15	36	11
Coop Books	29	7	13	41	10
Coop Main	27	10	12	40	11
RIX	22	3	16	56	3
Woolworth's	22	6	8	51	13
Average	30	8	13	39	10

"Curb Parking Study: A survey of curbside parking within the Harvard Square Area was also helpful in analyzing the Square's retail market. This survey, conducted through the use of mail-back postcards, indicated that among those cars parked in Harvard Square for the purpose of shopping, 25.7 percent belonged to residents of Cambridge and another 40.2 percent to residents of cities and towns abutting Cambridgeand across the Charles River. These two groups combined constitute 65.9 percent of all parkers whose main purpose for being in Harvard Square is shopping."

"Other Parking Studies: One-day studies of the two privately-operated lots on the former Baird-Atomic property on Mount Auburn Street and the City-owned lot at Bennett Street provided further assistance in studying the market. When the results of these surveys are summarized it is revealed that among the cars parked there for shopping trips, 27.5 percent belonged to Cambridge residents and 48.1 percent to residents of surrounding communities for a combined participation of 75.6 percent. This is somewhat higher than that found in the curb parking study, but it is still comparable."

"Personal Interview: A further approach to determining the retail market was to interview people as they entered and left stores. Of the persons interviewed 32.9percent confirmed an arrival by car. This compared with the 30 percent car arrivals found in the Gavin Study. Of the total arriving by car, 25.0 percent were Cambridge residents, 44.5 percent were from surrounding communities and the combined total was 69.5 percent. Again, there is a consistency with the 65.9 percent and 75.6 percent findings of the other two surveys."

"The similarity in the findings of these different approaches indicates that approximately 30 percent of the shoppers in Harvard Square arrive by car and about 70 percent of all shoppers can be considered to be residents of Cambridge and adjacent towns."

Property Values and Taxes

"Figure III-16 shows the 1970 assessed valuation of Harvard Square property. As one would expect, assessed value increases as one approaches the kiosk area of the Square. Table III-7 in this report notes the tax yield of major property owners.

Although Harvard University owns by far the greatest proportion of tax-exempt property in that area, it also contributes the largest amount of property taxes. On the other hand, except for Holyoke Center, all Harvard University owned property is assessed at less than $5.00 per square foot."

"A comparison of total assessed values in 1959 and 1971 indicates that there has been no major change in the locational pattern of value. Property valuations may have substantially increased but generally those with the highest values are still located in the center of the Square. The total assessed value per square foot is noticeably high ($15-$100) for those properties in the center of the Square and along Massachusetts Avenue, Brattle Street, and Brattle and Eliot Squares. The largest number of lots in the Harvard Square area are assessed at less than $2 per square foot with the median range of property assessments occurring between $10-$20 per square foot."

Table III-7

TAX YIELD OF MAJOR PROPERTY OWNERS
Harvard Square Core Area, 1971

	Total Sq. Ft. Land	Total Assessed Value	Total Tax Yield
Harvard University	335,619	$7,393,000	$978,899.40
Harvard Cooperative Society	30,996	1,129,500	149,545.00
Brattle Craigie Trust	49,511	1,003,600	132,876.64
Wasserman Development Corp.	33,781	540,000	71,496.00

"Since Harvard Square is one of the major retail centers in Cambridge it is a major income generating center for the City. As such its stability and steady growth are as important to the City as they are to area residents and merchants."

"The property tax return from Harvard Square is the largest for any single commercial area in Cambridge. Data based on 1970 assessments show the core area contributed $1.35 million compared to $0.9 million from Central Square, its nearest rival. Table 23 (Table III-8 in this report) shows the tax yield from a number of important commercial areas in Cambridge in descending order of tax yield."

Table III-8

ASSESSED VALUATION AND TAX YIELD
SELECTED BUSINESS AREAS

Cambridge, Massachusetts 1970
(Including Order of Tax Yield)

	Assessed Value	Acres	Tax Yield	Value of Tax-Exempt	Acres
Harvard Square	$12,294,700	13.6	$1,345,000	$6,627,300	6.4
Central Square	8,661,500	14.8	947,568	1,170,400	3.6
Technology Square	6,178,400	15.9	675,917	-	-
Porter Square	2,165,500	16.0	236,806	45,600	0.3
Inman Square	1,491,680	9.8	163,190	16,300	0.2
Alewife Brook Plaza	410,900	22.3	44,852	13,500	4.6

Total Cambridge Assessed Values = $316,000,000; 1970 tax rate - $109.40

Impacts

The socio-economic impacts of the Red Line Extension in Harvard Square must be divided into two sections: 1) the short-term impacts caused by construction and, 2) the long term impacts that result from the extension beyond Harvard Square and the possible relocation of the transit station.

Construction of the proposed project will cause temporary surface disruption in areas where cut-and-cover construction occurs. Because the areas most likely to be affected by surface disruption are in commercial rather than residential uses, primary impacts would be economic. Although members of the Harvard Square community will be inconvenienced, there will not be any significant change in social activity patterns as a result of construction. Homes will not be displaced; recreational areas will not be adversely affected; population and housing patterns will not change; and, in general, the community will not be severely impacted during construction.

There are several types of surface disruption associated with construction of the project. They are:

Excavations

In areas where cut-and-cover construction is necessary, the excavation can be covered with timber or metal decking to minimize interruption of surface activity. However, this decking will make pedestrian and vehicular access to buildings inconvenient. The project entails large areas of cut-and-cover construction on Massachusetts Avenue. Although this work requires some modifications of traffic patterns, the excavation will not adjoin buildings which are accessible from Massachusetts Avenue.

Parking Restrictions

On some streets it will be necessary to eliminate parking in order to maintain or increase capacities on those streets during the construction period. The proposed project will require moderate parking restrictions, including a reduction of parking on Garden Street, and in the city metered parking area beyond the Information Booth (Peabody Street).

As previously mentioned, the commercial sector stands to bear the brunt of the construction impacts. Whether a business is directly affected or not, the fact that a large construction project is underway in an area can deter persons from shopping in that area. In Harvard Square several aspects of the local economy will tend to minimize this effect. The predominance of non-automobile-oriented shoppers is one factor. Also, specialty shops constitute a large percentage of the total retail outlets in the area. This type of retail establishment suffers to a lesser degree during construction than does a retail activity which is duplicated a short distance away.

Extension Beyond Harvard Square

Transportation improvements tend to cause a net increase in total land value and property tax revenues in a community by creating greater economic efficiency through increased accessibility. This attracts new development capital to that community rather than to competing locations. In comparison to other station locations along the path of the Red Line, this effect will be muted in Harvard Square for two reasons. First, access to Harvard Square by rapid transit has been available for a number of years; and second, the Harvard Square area already has a number of features other than rapid transit service; such as, Harvard University, a unique retail sector, and a growing number of businesses and professional firms which can attract new development capital. The

fact that other areas will be receiving the benefits of a transportation improvement (i.e., the Red Line) will not adversely affect the Harvard Square economy. Harvard Square is presently an important retail and employment center and that position should be strengthened by the Red Line Extension.

NEIGHBORHOOD AND COMMUNITY FACTORS

Pedestrian Circulation and Neighborhood Cohesion

The location of the new subway entrance in the kiosk area combined with the proposed pedestrian area improvements will reduce the conflict between the automobile and the pedestrian. This will improve pedestrian walking in Harvard Square and maintain a compact commercial core and commercial spine.

Neighborhood Character

The Harvard Square Comprehensive Policy Plan states the following: "Today, the population composition of the Harvard Square area is changing and is increasingly youth-oriented, professional and single. Families, the elderly and young children no longer comprise a significant portion of the resident population except in the upper-income enclave to the west". The policy towards this condition is to expand the permanent based resident and employee population to counteract the present and projected trends of very transient and predominantly young population groups.

The new subway service will provide access to Porter Square and Davis Square. The diversity in the type of people attracted to and serviced in the square will be increased by the link to the northwest provided by the extension.

Public Facilities and Services - Schools, Police, Fire, Hospitals and Utilities

The subway extension will provide better access from the northwest to the services and activities offered by the universities in the Harvard Square area. Several utility lines and ducts will be relocated during construction of the station and transit line, but utility service will be maintained. On a long term basis, no new circumstances affecting existing public facility and service functions will be created.

PARKS, RECREATION, AND HISTORIC RESOURCES

The following is a description of the Open Space in the Harvard Square Area as prepared by the City of Cambridge, Department of Planning and Development--Volume 6, Physical Development.

> "There appears to be a generous supply of open space in Harvard Square, but on examination this is not the case. The reasons for this discrepancy are the differing locations and the ease of access to open space. Public open areas near the core are represented by the Cambridge Common, Flagstaff Park, the Burying Grounds, Harvard Yard, Forbes Plaza, Winthrop Park and the Charles River Reservation.

Cambridge Common

> The Cambridge Common is the largest open space near Harvard Square and the most under-utilized. Covering more than 8.5 acres, most of the area is inefficiently used. A small baseball field near Garden and Waterhouse Streets and a smalle tot play area near Follen Street are the only designed uses for the Common aside from sitting or strolling..... Its entrance, approximately 800 feet from the kiosk, separated by major traffic movements at Peabody Square, is more accessible to residents in surrounding houses and apartment buildings than to core area shoppers.

Flagstaff Park

> Flagstaff Park consists mainly of a flagpole set amidst some unviolated grass. It is very nearly inaccessible, located as it is across Peabody Street from the Harvard Yard. Moreover, it is not meant to be accessible; there are no sitting areas nor is there a direct entrance to the park, other than a small gate tucked away at the north end near the bus tunnel entrance.

Burying Grounds

> The Burying Grounds located between the Unitarian and Episcopal Churches, is also effectively "off limits" as an open space resource. It is largely an historic site, not by nature suited to much more than strolling, and for the most part closed to the public. Incidents of vandalism and littering have prompted the City to keep it closed for the most part.

Harvard Yard

Harvard Yard is almost another world within the busy atmosphere of Harvard Square. Occupying more than 7.5 acres, containing many trees and plantings, institutional structures and footpaths, this quiet, unhurried area is located opposite the kiosk. It does not seem to be heavily utilized especially by shoppers in the Square unless they also happen to be associated in some way with the University. It is a very pleasant change-of-pace place in contrast to the busy commercial core, and perhaps in time more non-university people will discover it.

Forbes Plaza

Forbes Plaza at the Holyoke Plaza on Massachusetts Avenue is more typical of a modern urban open space. Owned by Harvard University, it is nevertheless utilized principally and thoroughly as a gathering place for young people and others pausing to "people watch". The space is nicely designed but quite small, with some fairly good sized plantings and concrete benches. Its attraction seems to result largely from its central location and the activities generated there: folk singing, selling, and sometimes political or religious propagandizing.

Winthrop Square

Winthrop Square is a small (1/4 acre) urban park. Formerly, the site of Cambridge's open air market, its present value is largely passive recreation. It appears to be reasonably well cared for with flower beds in summer, but there are only three small sitting benches. However, when the weather is warm many young people congregate in the park on the grass and benches.

Charles River Reservation

The Charles River Reservation along the river banks on the southern frontage of Memorial Drive is a good 1,500-2,000 feet from the kiosk area across a very busy vehicular arterial. As such it is not a general open space resource for square users but it is a major regional open space heavily used by both residents and students, especially those in surrounding Harvard houses and dormitories."

The open spaces directly affected by this project would be Flagstaff Park and the southwest corner of Harvard Yard. The impacts are discussed later in this chapter.

Existing Historic Resources

Old Harvard Yard Historic District: The Old Harvard Yard Historic District was created to preserve the site where the first college in the United States was founded. The Old Yard is a large rectangular area which includes 19 buildings and is bordered on the south and west by Massachusetts Avenue, on the north by Cambridge Street, and on the east by additional property owned by Harvard University. This district is listed in the National Register of Historic Places.

Cambridge Common Historic District: The Cambridge Common Historic District was created to preserve an area which has served as a focal point for political, social, and religious activity in Cambridge for over 300 years. It is significant in a national sense because the Common served as a center for rebellious activity prior to the Revolutionary War and as a camp for George Washington's Continental Army. This district is listed in the National Register of Historic Places and includes the Cambridge Common, the bordering streets, and the surrounding land and buildings to a depth of 100 to 200 feet. Flagstaff Park is within this district.

The National Register status of these districts requires review of the proposed undertaking by the Massachusetts Historical Commission and the Advisory Council on Historic Preservation under Section 106 of the National Historic Sites Act of 1966. All significant structures and features within a National Register District are to be reviewed.

The City of Cambridge Historical Commission has prepared "Evaluation of Buildings and Sites Within the Area Surveyed for MBTA Realignment in Harvard Square". This information is included in the supplemental information available from the MBTA on request.

Buildings are organized by location and evaluated in terms of their Historical (H), Architectural (A), and Environmental (E) significance. These judgements are summarized in a rating system in which Grade 1 buildings are of primary importance. Grade 2 buildings are very important, Grade 3 buildings are important, and Grade 4 buildings are moderately important.

Official status of individual structures is noted as follows:

NR District: National Register District
CHC District: Cambridge Historical Commission District

Structures potentially within the zone of influence of the project include:

NR District 1. Massachusetts Hall, 1718

1: Primary Importance
H: Harvard's oldest building
A: Prototype of 18c. college hall in New England
E: Essential element of Yard

NR District 2. Wadsworth House, 1726

1: Primary Importance
A: Fine early 18c. house, though modified
H: Residence of Harvard presidents, 1726-1849; only reminder of 18c. directly visible from Massachusetts Avenue

NR District 5. Harvard Hall, 1764, enlarged 1842, 1870

1: Primary Importance
H: First college building in America entirely devoted to academic (non-dormitory) uses
A: Excellent Georgian II architecture enhanced by three remodelings
E: Essential element of Yard

NR District 16. Lehman Hall, 1924, Coolidge, Shepley, Bulfinch, Abbott

1: Primary Importance
E: Essential to scale and privacy of Yard; visually dominates and defines space of Harvard Square

NR District 17-18. Lionel and Mower Halls, 1925: Coolidge, Shepley, Bulfinch, Abbott

1: Primary Importance
E: Essential elements of Yard

NR District	19.	Straus Hall, 1925: Coolidge, Shepley, Bulfinch, Abbott 1: Primary Importance E: Essential to scale and privacy of Yard
NR District (part)	25.	Memorial fence and all gates, 1899 ff: McKim, Mead and White 1: Primary Importance E: Essential to unity and privacy of Yard
NR District CHC District	73.	First Parish Church Unitarian, 1833: Isaiah Rogers 1: Primary Importance H: Fifth meeting house erected by congregatio... a Cambridge landmark A: Through stripped of ornamentation, still represents Gothic Revival
NR District CHC District	135:	Harvard Epworth Methodist Church, 1891: A.P. Cutting 3: Important A: Moderately good example of Richardson Romanesque
NR District CHC District	136.	Hastings Hall, 1888: Cabot and Chandler 3: Important A: Good example of Medieval Revival Style E: Creates spatial definition on one side of Common
NR District CHC District	140.	Gannett House, 1838 4: Moderate Importance A: Example of Greek Revival temple house E: Poorly related to Common and to other buildings in North Yard

Subway Kiosk, 1928: architect unknown

2: Very Important
A: Sound design and massing, excellent scale presently obscured by signs and poles
E: Essential element of Harvard Square, with important symbolic associations.

Impact on Historic Properties

Old Harvard Yard District

The proposed Harvard Square Station will be built alongside the Old Harvard Yard District. A number of buildings within the district are close to the location of the proposed construction and have appreciable architectural or historic importance: Wadsworth House, Lehman Hall, Straus Hall, Massachusetts Hall, Harvard Hall, Lionel Hall, and Mower Hall. Of these eight buildings, only Straus, Lehman and Wadsworth Halls are sufficiently close to construction that they may be directly affected by it.

The alignment of the proposed tunnel would necessitate excavation from the surface along a line passing close to the aforementioned three buildings and would encroach upon a strip of yard space fronting Lehman Hall. To protect these buildings from settlement stresses, a trench-cut slurry wall is proposed which would retain and stabilize the earth behind the line of excavation. Previous experience with the slurry wall construction technique has shown that damage to adjacent buildings at best is non-existent and at worst is insignificant. The quality of workmanship would be controlled to ensure that little or no damage occurs. Approximately 250 lineal feet of masonry and iron fencing bordering the Lehman Hall site would be temporarily removed. Salvageable components such as dressed stone and ornamental iron would be catalogued and stored for re-use. The fence would be rebuilt to match the present design after primary sub-surface construction is completed. All disturbed land scaping and paving would also be renewed. All restoration work would be done in consultation with the Massachusetts and Cambridge Historical Commissions.

The existing kiosk in Harvard Square is considered contiguous to this district by the Massachusetts Historical Commission. It is their request and recommendation that "The retention and re-use of the 1928 Subway kiosk.... should be studied in depth.... request an opportunity for my review of this area of concern at the earliest study and design stage." The Cambridge Historical Commission is also interested in the preservation of the kiosk and has reached an agreement with the MBTA to retain the kiosk.

Cambridge Common Historic District

None of the many important buildings in the District would be directly affected by the project. However, station construction in Massachusetts Avenue would occur about 30 feet away from the First Church, Unitarian, and though no adverse effects are anticipated, a monitoring program would be implemented as a precautionary measure. If monitoring data indicated that the Church building was beginning to respond to construction activity, preventative measures would be initiated to eliminate the cause.

The proposed alignment would pass through Flagstaff Park (formerly called the "Little Common") which is within the District. Construction would require the removal of about 27 trees, mainly oaks, maples, and elms of small to medium size. In cooperation with the Cambridge Historical and Conservation Commission, the affected area would be re-landscaped with plantings of trees, shrubs and grasses upon completion of construction. Temporary removals would include a flagpole monument, a statue monument, a formal paved terrace, ornamental masonry garden walls and balustrades. These would be restored. It will also be necessary to locate a permanent ventilation opening in the park which will be about 400 square feet in area, covered by permanent grating.

A very small section of lawn and fencing at the northeast corner of the intersection of Cambridge Street and Massachusetts Avenue would be disturbed by tunnel construction. The affected area would be restored to its existing condition.

All restoration and landscaping work will be done in consultation with the Massachusetts and Cambridge Historical Commissions.

Ecology

The proposed Red Line Extension in the Harvard Square area includes a section of cut-and-cover construction which will take place in Flagstaff Park. The process of excavation for the tunnel will necessitate the removal of a number of trees currently growing in the park. These will most likely include: 2 ashes, 3 sumacs, 13 elms, 4 oaks, 3 maples, 1 poplar, 1 crab apple and a number of bushes and plants. The trees range in size from 6 inches to 36 inches in diameter. Although some of the smaller trees may be replanted, the majority will probably be discarded and replaced by new landscaping after construction is completed. Dewatering of the trench for the proposed tunnel may result in a lowering of the water table in the area. This in turn will necessitate special watering of trees in the park not directly affected by construction.

It will be necessary to locate a ventilation shaft approximately 400 square feet in area at the north end of the park.

Air Quality

Existing air quality data from sampling stations near the project corridor are analyzed in detail in Section II-C of Appendix H. The material which follows is intended to augment that analysis by discussion of some results from a study for the proposed John F. Kennedy Library.

In the Draft Environmental Impact Statement for the John F. Kennedy Library, air quality data was collected over a 60-day monitoring period in April, May and June 1974 at two critical locations, one being Harvard Square. This site was located at 1384 Massachusetts Avenue in the southwest corner of Harvard Square. A carbon monoxide monitor was the only ambient air quality instrument located at Harvard Square. The other site, at the intersection of Memorial Drive and Boylston Street, was used to sample the ambient levels of carbon monoxide, sulfur dioxide, total suspended particulates and lead fraction.

Carbon monoxide was the only sampled pollutant that exceeded air quality standards. During the 60-day monitoring period, the one-hour Federal standard 35 ppm was exceeded once. This occurred on June 20, 1974. The carbon monoxide concentration was determined to be 35.6 ppm. The referenced Draft Environmental

Impact Statement (DEIS) states that the single concentration does not represent a violation of the standards, since the one-hour standard is not to be exceeded more than once a year. However, at both monitoring sites, the measurements showed both the State and Federal eight-hour carbon monoxide standards being exceeded 60 to 70 percent of the time.

In the referenced DEIS, detailed modeling simulations were conducted for the estimated year of completion of the JFK Library Complex-1978 and 1981. The conclusions were that for all cases, predicted carbon monoxide levels will be within air quality standards established by the State and Federal authorities.

From the above discussion, one would conclude that a Red Line Extension in Harvard Square will not produce an adverse air quality impact for the following reasons:

- Number of diesel buses to the Square are being reduced.

- Reduction of number of vehicles traveling through the area as a result of Red Line Extension.

- Analysis has shown that CO concentrations will be reduced in design year without the project.

The construction of the type of subway facility being proposed for Harvard Square will produce dust--normally associated with excavation, demolition and reconstruction. For instance, modification of the existing Harvard Station will require use of the type of equipment that, by the very nature of its operation on concrete, will produce dust. This impact will be mitigated by the following:

- Provide a deck over the construction with adequate ventilation for construction workers.

- Provide adequate water supply to control the dust.

NOISE AND VIBRATION

Harvard Square and its environs can be characterized as a high density urban area which includes a unique blend of commercial enterprise, residential housing, school buildings (libraries, classrooms and housing), and recreation areas. Associated with such concentration of activity is a great deal of vehicular and pedestrian traffic which often reaches the saturation point. Construction projects abound, especially during the summer months when public works projects, building construction and renovation activities are at their peak.

One by-product of this intense activity is a pervasive din which, as it will be seen later, is essentially continuous throughout the day and evening. The dominant noise source in the area is street traffic, with trucks, buses and motorcycles setting the peak noise levels and cars contributing significantly to the average noise levels. Other major sources of noise in Harvard Square are construction projects, which contribute to the peak noise levels in the immediate areas of their locations for fixed equipment and in a wider area for mobile equipment. A visit to Harvard Square gives one the general impression that the higher noise levels are associated with the Square itself and the major streets leading to the Square, and that lower noise levels can be associated with the residential areas some distance from the major streets and the square. It is the purpose of this part of the study to quantify these general impressions in order that the impact of any change from the present conditions can be assessed.

Measurement Program

One of the most important parts of the characterization of ambient noise levels in an area is the measurement site selection process. The selected sites must be chosen carefully to avoid bias in the final results.

Measurement sites were selected from among two primary categories:

1. Sites near major streets,

2. Sites shielded from major streets by at least one row of buildings.

Measurement locations within these primary categories were further classified by noting the land use categories as follows:

a. Sites in residential areas where people sleep.

b. Sites near acoustically sensitive buildings during daytime (0700-2200 hours).

c. Sites in commercial areas.

d. Sites near a proposed station.

Six sites were chosen for 24-hour continuous sampling* by a Portable Noise Monitoring System which samples the sound level 8 times every second for 24 hours.

Use of this equipment enables measurement of the hourly and daily equivalent sound level and any of the statistical descriptions of noise. In addition to the 24-hour sites, six sites were chosen for shorter-term noise samples to provide supplementary information on the statistical measures of noise. All sites are shown in Figure III - 17.

Existing Noise Levels in Harvard Square

A summary of measurement results taken in the Harvard Square area in connection with the Kennedy Library Study (C. E. Maguire, Inc., 1975) are shown in Tables III-9 and III-10 where supplementary data has been included. From the tables one can see that sites near major streets are exposed to daytime** equivalent sound levels of approximately 70 dB, nighttime equivalent sound levels in the higher 65 to 70 dB range, and peak hour L_{10} in the 70 to 80 dB range.

Sites shielded from major streets are exposed to daytime

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*-At two sites the 24-hour samples were measured in the summer and again in the fall in order to document any changes which may result from tourist activity giving way to school activity.

**-"Daytime" is defined as 0700-2200 hours, the remaining hours are "nighttime" hours.

Table III-9

SUMMARY OF RESULTS FROM 24-HOUR
NOISE LEVEL SAMPLES

Site	Site Category	Date	L_{eq} (Day) (0700-2200 hrs.) (dB)	L_{eq} (Night) (2200-0700) (dB)	L_{dn} (dB)	L_{10}, (dBA) (Peak Noise Hour)	Comments
Brattle Square (38 Brattle St.)	1,c,d	8 August 74	73	67	75	79 (1300-1400 Hrs.)	Summer activities
Brattle Square (38 Brattle St.)	1,c,d	8 October 74	72	67	74	77 (1400-1500 Hrs.)	Fall term classes in session
16 Hilliard St.	2,a	10 August 74	55	53	60	59 (1700-1800 Hrs.)	Summer activities
16 Hilliard St.	2,a	10 October 74	59	54	61	64 (0900-1000 Hrs.)	Fall term classes in session
Harvard Yard (Sever Hall)	2,b	12 August 74	63	52	63	69 (0900-1000 Hrs.)	Summer
Flagstaff Park (Mower Hall)	1,a,d	9 August 74	71	68	75	72 (1800-1900 Hrs.)	Summer
1583 Mass. Ave. (Pound Building)	1,b	9 October 74	69	64	72	73 (0800-0900 Hrs.)	Fall term classes in session
Boylston St. (Eliot House)	1,a	11 October 74	69	67	74	74 (1800-1900 Hrs.)	Fall term classes in session

Table III-10

SUMMARY OF RESULTS FROM SHORT TERM NOISE LEVEL SAMPLES, INCLUDING RESULTS FROM THE KENNEDY LIBRARY ENVIRONMENTAL IMPACT STATEMENT

Site	Date	Site Category	L_{10} (dBA) (Hour Sampled)	Comments
Radcliffe Yard	12 August 74	2,b	59 (1700-1800)	Aircraft, Construction, Trucks
Radcliffe Yard	15 August 74	2,b	57 (1000-1100)	Aircraft, Construction, Trucks
Brattle St. at Farwell Place	12 August 74	1,b	67 (1600-1700)	Trucks, Cars
Holyoke St. between Mass. Ave. and Mt. Auburn St.	12 August 74	1,c	67 (1800-1900)	Traffic on Mass. Ave. and Mt. Auburn St.
Mt. Auburn St. at Athens St.	27 February 75	1,c	75 (1300-1400)	
Prescott St. (across street from Harvard Faculty Club)	27 February 75	2,a	63 (1300-1400)	
Harvard Yard	27 February 75	2,a,b	71 (1300-1400) 63 (1300-1400)	Aircraft No Aircraft
University Rd.* Seminary	Summer 74	2,a	57 (Peak)	Dead end street
Boylston St. between Eliot and Kirkland Houses	Summer 74	1,a	71 (Peak)	
Mt. Auburn and University Rd.*	Summer 74	1,a	71 (Peak)	
Mass. Ave. - Harvard Hall*	Summer 74	1,b	72 (Peak)	
Brattle St. at Ash St. - Graduate Center*	Summer 74	1,a	69 (Peak)	
Mt. Auburn at Hilliard St.*	Summer 74	1,a	68 (Peak)	
Memorial Dr. at Ash St.*	Summer 74	1,a	71 (Peak)	
Harvard Square*	Summer 74	1,c,d	78 (Peak)	
Mass. Ave. - Putnam Square*	Summer 74	1,c	76 (Peak)	
Mass. Ave. - Wigglesworth Hall*	Summer 74	1,a,d	70 (Peak)	
Cambridge Common*	Summer 74	1,d	74 (Peak)	
Brattle Square*	Summer 74	1,c,d	73 (Peak)	
Mt. Auburn at Bow St.* (Lampoon Building)	Summer 74	1,c	72 (Peak)	

* Supplementary data from Kennedy Library Environmental Impact Statement. (GSA, 75)

L_{eq}'s of lower 50 to 60 dB range, and peak hour L_{10} in the higher 50 to 60dB range.

A clearer impression of the time variation of noise levels can be gained from Figure III-18, where the hourly equivalent sound level ranges at each of the two site categories are plotted. Sites near major streets show noise exposures around the 60 dB level, with a corresponding fall-off in levels in the early-morning hours.

Figure III-19 shows the hourly L_{10}'s for the 24-hour sites. Here, the feature worth noting is the almost uniform distribution of L_{10} during the daytime at the sites measured in the Harvard Square area which enables one to sample the L_{10} at virtually any time during the day.

Measurements of the Vibration Environment

The vibration environment is measured as part of this study for two reasons:

1. To estimate the noise and vibration levels in buildings near the proposed subway extension alignments based on a model developed by Bolt,Beranek and Newman, Inc.; some of the measurements made were used to verify this model for the Harvard Square area.

2. The remaining measurements were used to document existing noise and vibration levels in buildings which may be affected by one or more of the proposed alignments.

To verify the prediction model, simultaneous measurements of the acceleration of the subway tunnel wall and a basement wall of a nearby building in two different locations were recorded on magnetic tape. In the immediate Harvard Square area, measurements were made at the southeast end of the Harvard Square Station upper level and at the same time inside Wigglesworth Hall, a Harvard dormitory along Massachusetts Avenue. A similar program of simultaneous measurements was conducted at the Polyarts Center at 863 Main Street in Cambridge where vibration levels were obtained for higher train speeds. Figure III-20 shows typical data obtained at these sites. In the tunnel, vibration measurements were made on the invert and on the wall; inside Polyarts, measurements were made on the ground floor.

In order to determine noise and vibration levels in buildings which might be affected by one or more of the proposed extension alignments, measurements were taken inside the Loeb Drama Center, Fay Hall (Radcliffe Yard), Harvard Science Center, and Epworth Church. The vibration levels measured on the main floor of these buildings are shown in Figure III-21. Measurements of the floor vibrations in these buildings were made with a person walking in the vicinity of the measurement location; in general, this raised the vibration level to the threshold of perception in the octave bands centered at 16 and 31.5 Hz.

One general conclusion which can be drawn from the vibration measurements is that the floor vibration levels in these sensitive buildings (drama center, university buildings, church) are now below the threshold of vibration perception and that the levels can rise to the threshold of perception with people walking on the floor nearby. With the exception of unusual cases, it is reasonable to assume that the present ambient vibration levels in other buildings in the Harvard Square area may be of the same magnitude. For the future extension of the Red Line, care should be taken to keep vibration levels in buildings adjacent to the alignment below the threshold of perception; in the discussion of noise and vibration control measures, it is shown that this is well within the present state-of-the-art.

Although the passage of a train in a tunnel can often be heard in rooms of nearby buildings, the level of this sound should not be so high that it interferes with activities which take place in the building. For this reason, noise levels were observed during periods of no other activity inside the same four buildings in the Harvard Square area in which vibration level measurements were made. The objective was to see what sound levels now exist in order to aid in establishing noise level criteria for buildings near the extension.

The results are shown in Table III-11.

Table III-11

INTERIOR SOUND LEVELS

Location	Average* Sound Level	Peak Sound Level (source)
Loeb Drama Center	40 dBA	43 dBA (truck)
Fay House		
Radcliffe President's Office	38 dBA	46 dBA (truck)
Dean Elliot's Office	34 dBA	40 dBA (truck)
Epworth Church		
Theater Section	35 dBA	55 dBA (truck)
Chapel	30 dBA	44 dBA (truck)
Harvard Science Center	48 dBA	--

The peak sound level was usually caused by traffic outside the building.

---

* "Average" is used here to describe the observed central tendency of sound levels during a ten minute daytime sample.

Impacts

Noise and vibration level estimates were made at 38 selected sites near the proposed Red Line Extension alignments, as shown in Table III-12. In performing these estimates, it was assumed that the extension would incorporate welded rail and rail fasteners with a stiffness of 500,000 lb/in-typical of the Landis fastener under load (Paolillo, 1973). Also in Table III-12 is the sound level criterion assigned to each site. No estimate was made of noise and vibration levels for buildings more than 200 feet from any given alignment, because neither noise nor vibration should be detectable at such distances for the type of soil in the Harvard Square area.

Table III-12 should only be used to identify locations along each alignment where noise control measures should be implemented. Locations where noise criterion are exceeded without special subway noise control measures are summarized in Table III-13. The nearly equal distribution of noise sensitive sites on this list reflects the fact that the Harvard Square area is dense with sensitive sites.

Airborne noise from the Station and Tunnel will be transmitted to the surrounding community by blast or ventilation shafts, entrances and mechanical ventilation equipment. Transmissions from these elements should be less than ambient noise levels near the openings. Acoustical linings in blast and ventilation shafts, baffles, and sound attenuators on mechanical ventilation devices are examples of control methods that can be used to achieve acceptable noise levels.

In later design phases, a 24-hour continuous ambient noise monitoring survey will be conducted to determine the statistical noise exposure profile. This information will confirm day and nighttime L_{90} levels and be the basis for establishing criteria at each location of a possible airborne noise source.

Table III-12

ESTIMATED NOISE AND VIBRATION LEVELS IN BUILDINGS NEAR THE PROPOSED SUBWAY EXTENSION ALIGNMENTS

SITES	SOUND LEVEL CRITERIA (dBA, re $2 \times 10^{-5} N/m^2$	ESTIMATED A-WEIGHTED INTERIOR SOUND LEVELS CAUSED BY SUBWAY TRAIN PASSAGES (dBA re $2 \times 10^{-5} N/m^2$)	ESTIMATED VIBRATION ACCELERATION LEVELS CAUSED BY SUBWAY TRAIN PASSAGES (dB, re 1.0g)
		D2	D2
1. Treadway Inn	40		
2. Proposed Holiday Inn	40		
3. Hilliard Street Residences	35		
4. Wm. Brattle House	40		
5. Dexter Pratt House	40		
6. Loeb Drama Center	30		
7. Library (Radcliffe Institute)	40		
8. Agassiz Theater	30		
9. Fay House	35		
10. First Church	30		
11. 7 Waterhouse Street	40		
12. Church of Christ Scientist	30	32	-54
13. Epworth Church	30	60	-48
14. Christ Church	30		
15. First Church	30	47	-53
16. Gannet House	40	54	-50
17. Austin Hall	40	34	-54
18. Harvard Science Center	40		
19. Memorial Hall	30		
20. Mower Hall	35	27	-62
21. Lionel Hall	35	35	
22. Holden Chapel	35		-60
23. Strauss Hall	35	57	-53
24. Harvard Hall	35	30	-58
25. Massachusetts Hall	35	31	-58
26. Widener Library	40	37	-56
27. Lamont Library	40	48	-55
28. Carpenter Center	40		
29. Fogg Art Museum	40		
30. St. Paul's Church	30	25	-55
31. Lampoon Building	40		
32. Mt. Auburn Street Residences	35	35	-52
33. Cambridge Common	-	-	-48
34. Wigglesworth Hall	35	60	-50
35. Claverly House	35		-56
36. Quincy House	35		
37. 1 Garden Street	35		
38. Memorial Church	30		

Table III-13

AREAS REQUIRING SPECIAL NOISE AND VIBRATION CONTROL

LINE	AREA
D2	Harvard buildings along Mass. Ave. (Lamont Library, Wigglesworth, Wadsworth, Lehman, Straus, Gannet, Walter Hastings), Epworth Church

CONSTRUCTION IMPACTS

The major adverse impacts of construction would be air and noise pollution, traffic disruptions, maintenance of relocating of utilities, siltation and erosion, effect on existing structures, disposal of excavated materials, spillage, effects on groundwater table and possibility of encountering an underground stream. A discussion of the general construction impacts can be found in Chapter II. The remaining portion of this section discusses specific construction impacts applicable to this segment.

Noise and Vibration

The degree of impact at the facade of nearest building is expected to range from some to severe depending on the phase of construction and the equipment to be used. For discussion of these impacts, see Chapter II.

Traffic Disruption

Temporary transit stations will be required during the construction period. One station will be located on the opposite side of the tracks from the existing platforms. The other would be at the Eliot Street Yard. For a discussion of these stations, see Page III-10.

Disruption to surface travel would be limited to Massachusetts Avenue from Holyoke Center to the Cambridge Common. Phased construction procedures will enable traffic movements to be maintained at existing levels. The staged construction will result in tunnel bus and surface bus boarding and layover locations. Bus circulation during construction is discussed on Page III-35 .

Displacements

Displacement at Harvard Square would be limited to one business--the out-of-town newstand located adjacent to the existing Harvard Square kiosk. During construction this business would be relocated in the temporary station and then moved to the new station once it opens.

Commercial Activities

During construction, stores on the west and south sides of the kiosk area may be affected by a reduction in parking spaces. Sidewalks infront of retail stores would not be disrupted. For further

discussion on the socio-economic impacts of construction in the Harvard Square area, turn to Page III-52.

Utilities

There are several utility lines to be relocated or maintained in the Harvard Square Area. The major utility is a 48-inch diameter MDC water line.

Disposal of Excavated Material

It is estimated that there will be approximately 94,000 cubic yards of excavation on this project.

Historic Properties

For a discussion of the Impact on Historic Properties, see Page III-60.

4F SITES IN HARVARD SQUARE AREA

LEGEND :

- CAMBRIDGE COMMON HISTORIC DISTRICT
- OLD HARVARD YARD HISTORIC DISTRICT

NR--- NATIONAL REGISTER DISTRICT
CHC- CAMBRIDGE HISTORIC DISTRICT
NHL- NATIONAL HISTORIC LANDMARK
NRS- NATIONAL REGISTER SITE

HISTORIC SITES:

1	WADSWORTH HOUSE	NR
2	LEHMAN HALL	NR
3	STRAUS HALL	NR
4	MASSACHUSETTS HALL,	NR,NHL,CHC
5	HARVARD HALL	NR,CHC
6	LIONEL HALL	NR
7	GANNET HOUSE	NR,CHC
8	HASTING HALL	NR, CHC
9	HARVARD-EPWORTH CHURCH,	NR,CHC
10	FIRST PARISH CHURCH UNITARIAN,	NR, CHC
11	CHRIST CHURCH	NR,NHL,CHC
12	1 GARDEN ST.	NR,CHC
13	FAY HOUSE	NR,CHC
14	LONGFELLOW HALL	
15	77 BRATTLE STREET	
16	42 BRATTLE STREET	NRS
17	54 BRATTLE STREET	NRS
18	76 BRATTLE STREET (GREENLEAF HOUSE)	

CAMBRIDGE COMMON

OLD BURYING GROUND

PARK/RECREATIONAL SITES:

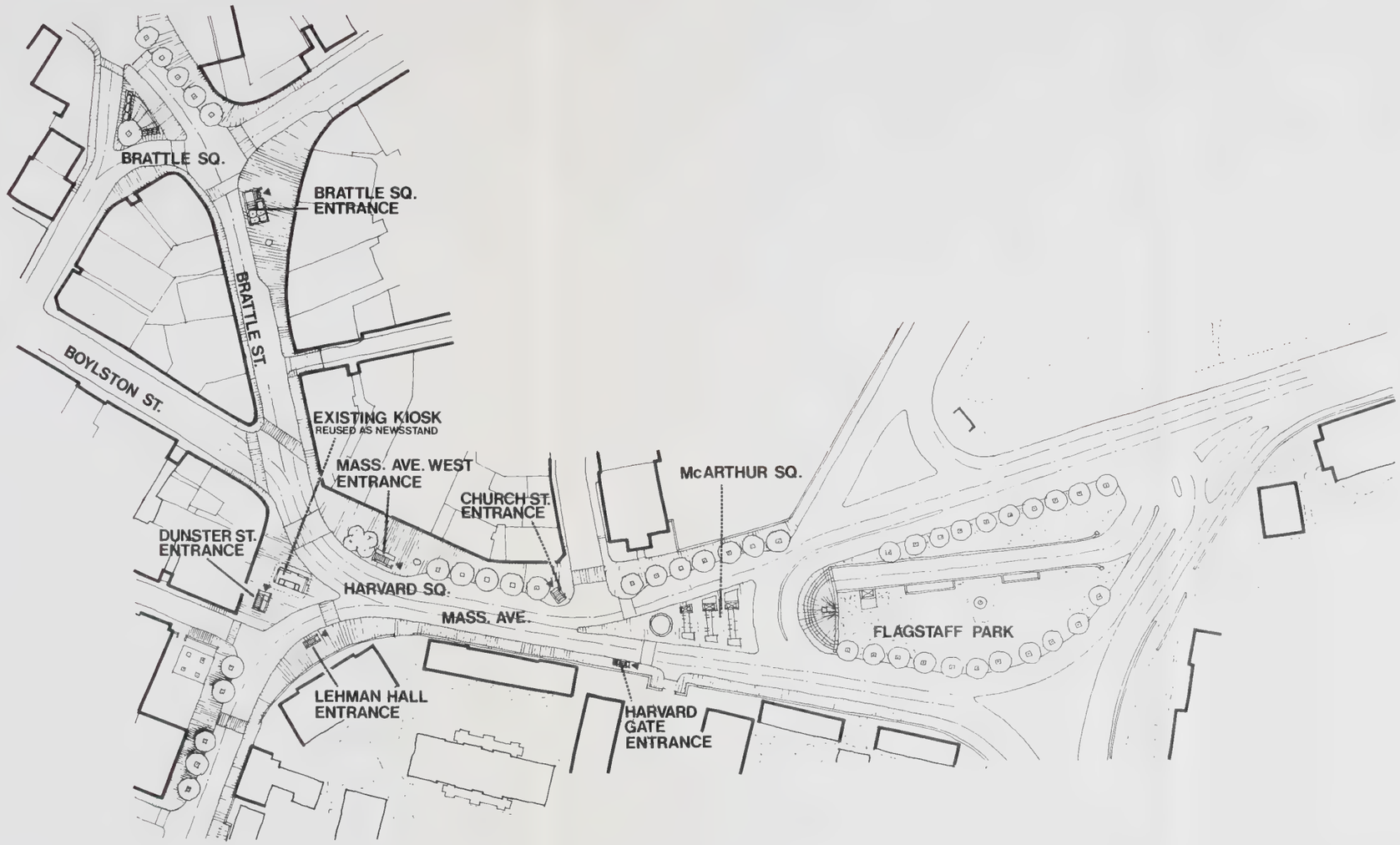
CAMBRIDGE COMMON

FLAGSTAFF PARK

NORTH LITTLE COMMON

Massachusetts Bay Transportation Authority

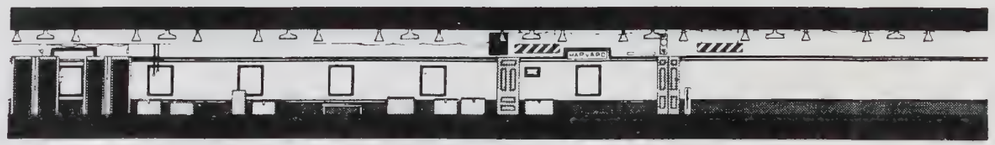
HARVARD SQUARE
EXISTING CONDITIONS
0 100 200 FEET 400
FIG III-1



Source: Skidmore Owings & Merrill

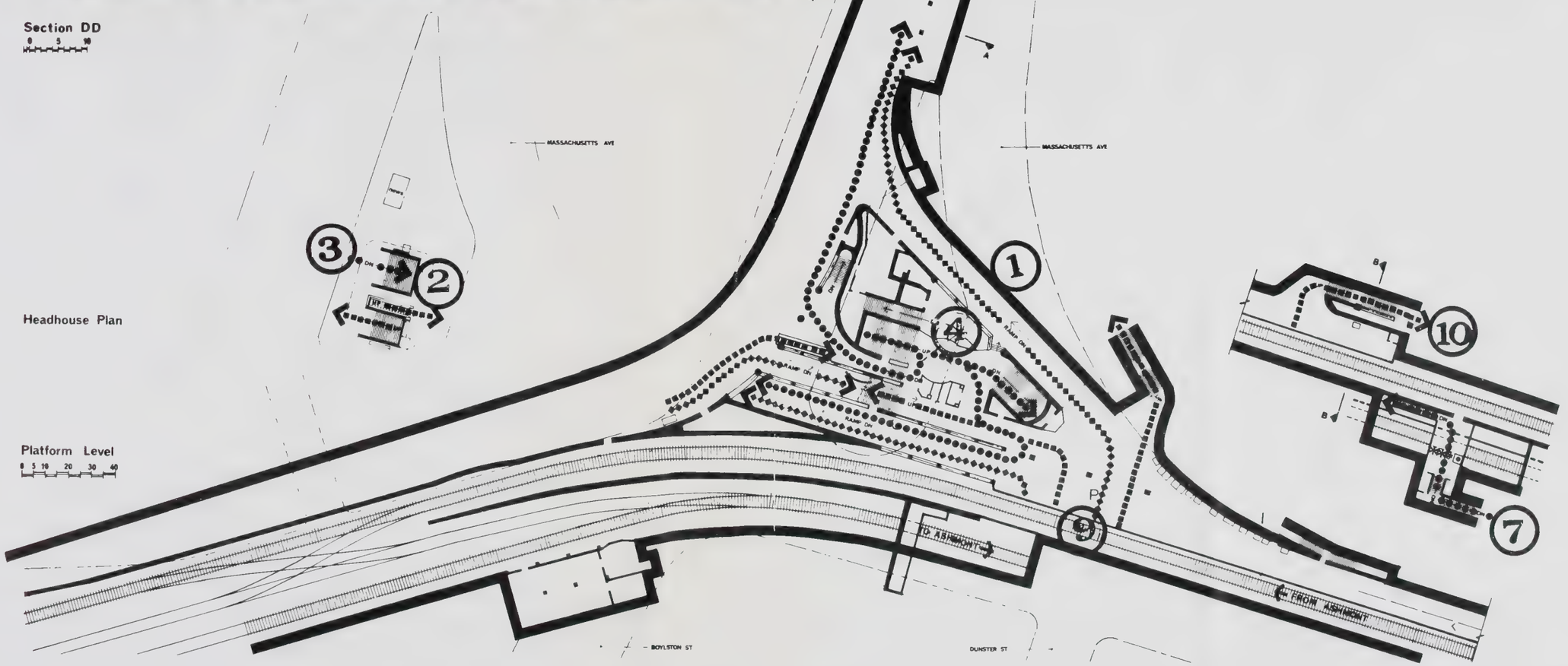
RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

HARVARD SQUARE
SITE PLAN
FIG. III - 2



Section DD

0 5 10



Headhouse Plan

Platform Level

0 5 10 20 30 40

SYMBOL KEY

- ENTERING CIRCULATION
- TRANSFER CIRCULATION
- CHANGE BOOTH
- EXITING CIRCULATION
- ENTRANCE TURNSTILE
- PASSIMETER
- GRAPHICS
- EXIT GATE
- ADVERTISING

* Source: M.B.T.A. Manual of Guidelines and Standards

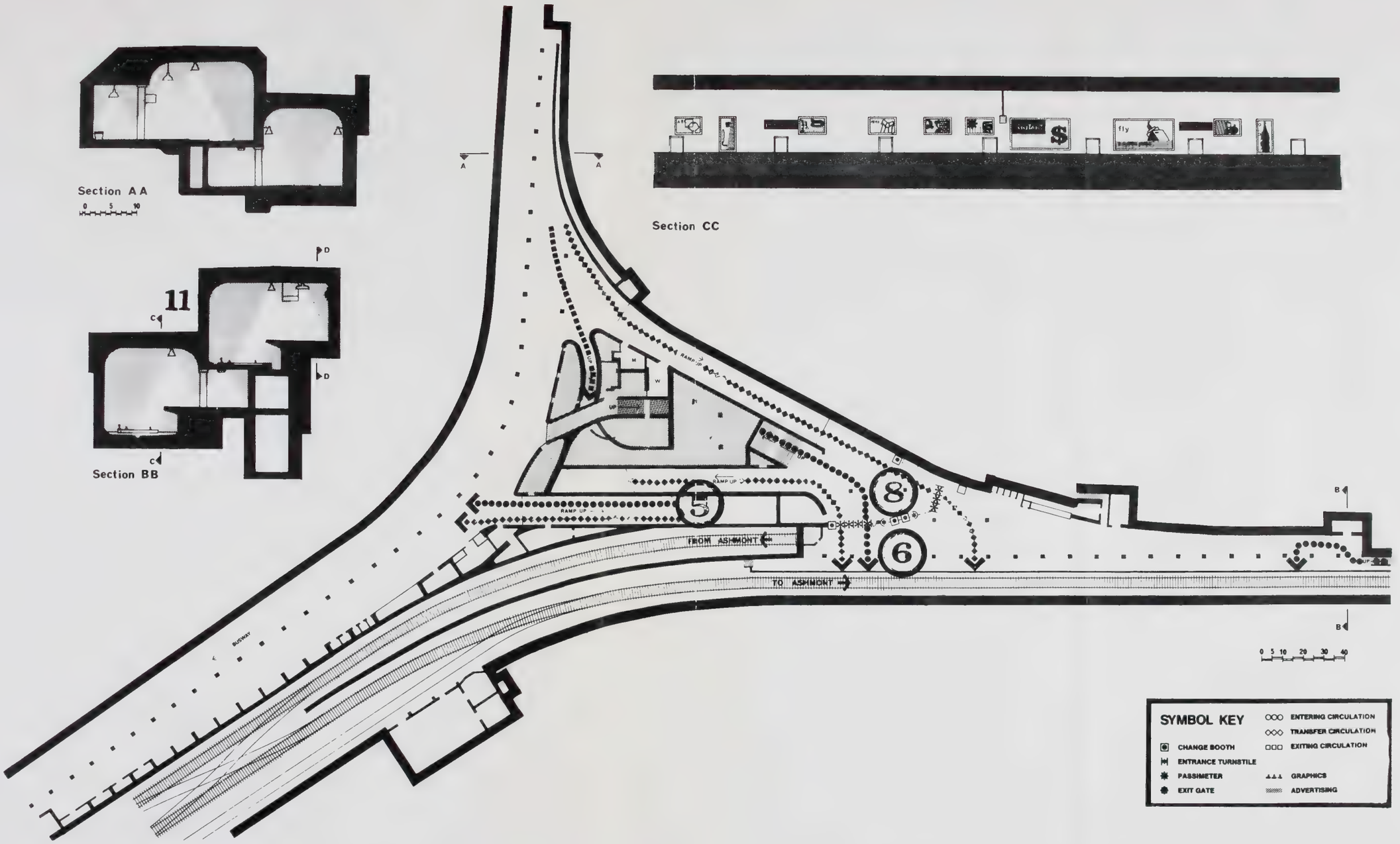
NOTE: Numbers Shown are Referenced on Pages VI-1 & VI-2

Section AA

0 5 10

Section BB

Section CC



SYMBOL KEY	
CHANGE BOOTH	ENTERING CIRCULATION
ENTRANCE TURNSTILE	TRANSFER CIRCULATION
PASSIMETER	EXITING CIRCULATION
EXIT GATE	GRAPHICS
	ADVERTISING

*Source: M.B.T.A. Manual of Guidelines and Standards

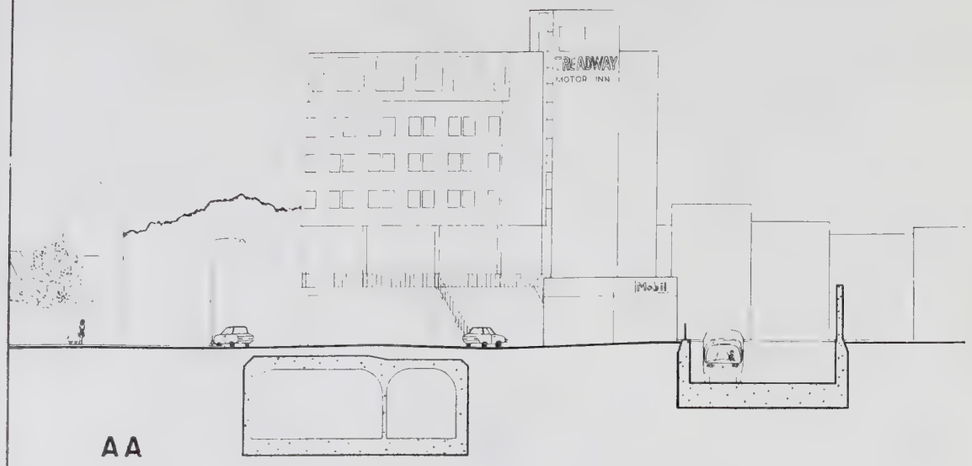
NOTE: Numbers Shown are Referenced on Pages VI-1 & VI-2

Massachusetts Bay Transportation Authority

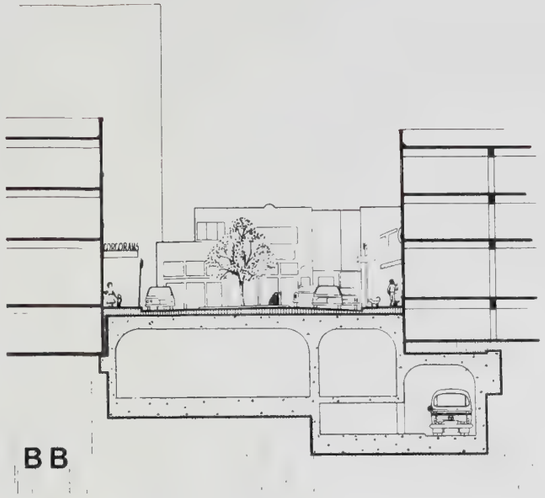
HARVARD SQUARE
EXISTING STATION
LOWER LEVEL FIG. III-4

RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

HARVARD SQUARE
PLAN RELATED TO
STEETS AND BUILDINGS FIG III-5



AA



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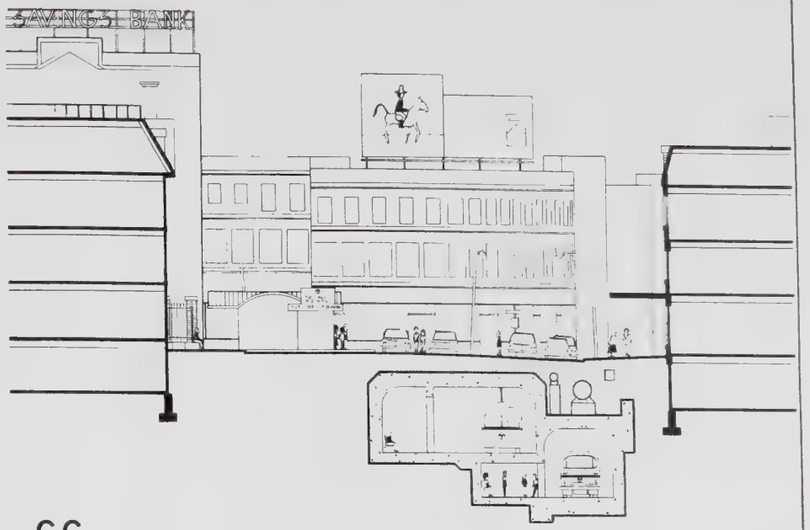
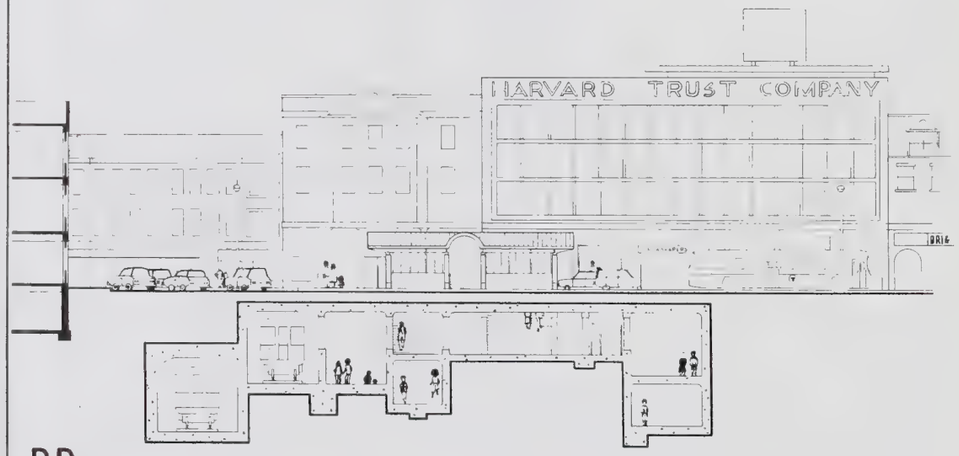
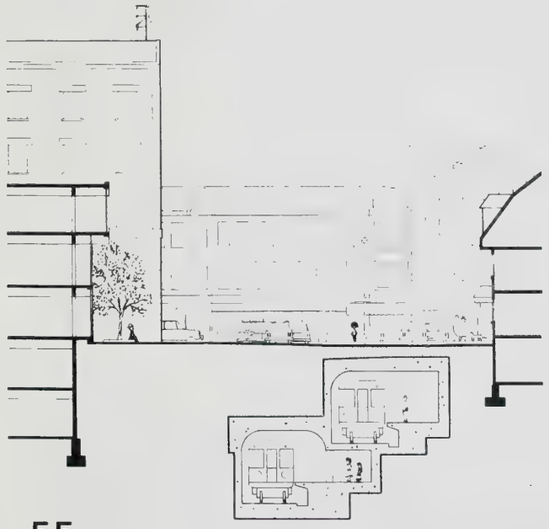


CC



DD



EE

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HARVARD SQUARE
EXISTING STATION
SECTIONS FIG III-6

KIOSK

*Source: M.B.T.A Manual of Guidelines and Standards

LOWER LEVEL PLATFORM

RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

HARVARD SQUARE

EXISTING STATION
SURFACE AND INTERIOR VIEW
FIG. III – 7

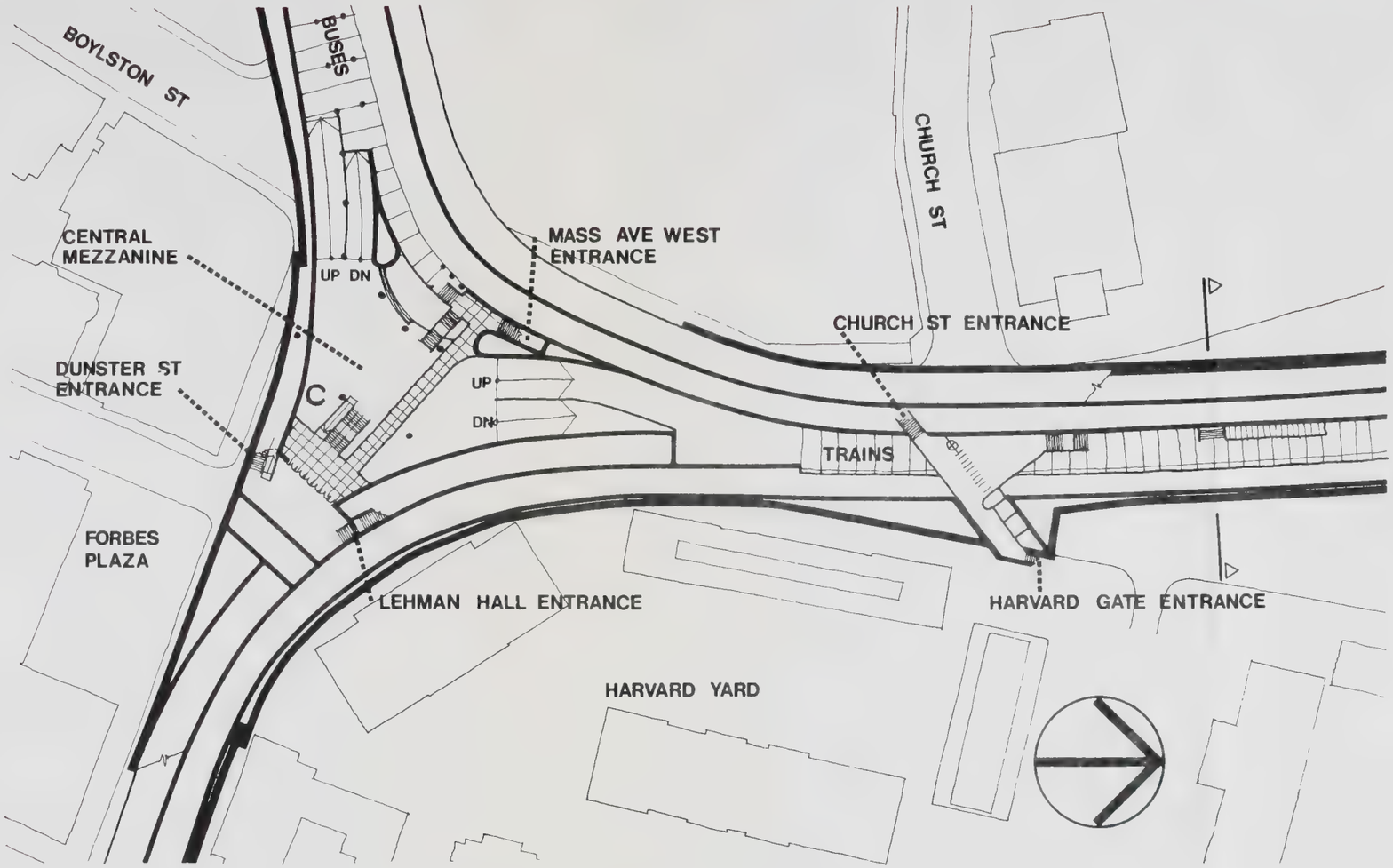
MEZZANINE

UPPER LEVEL PLATFORM

* Source: M.B.T.A. Manual of Guidelines and Standards

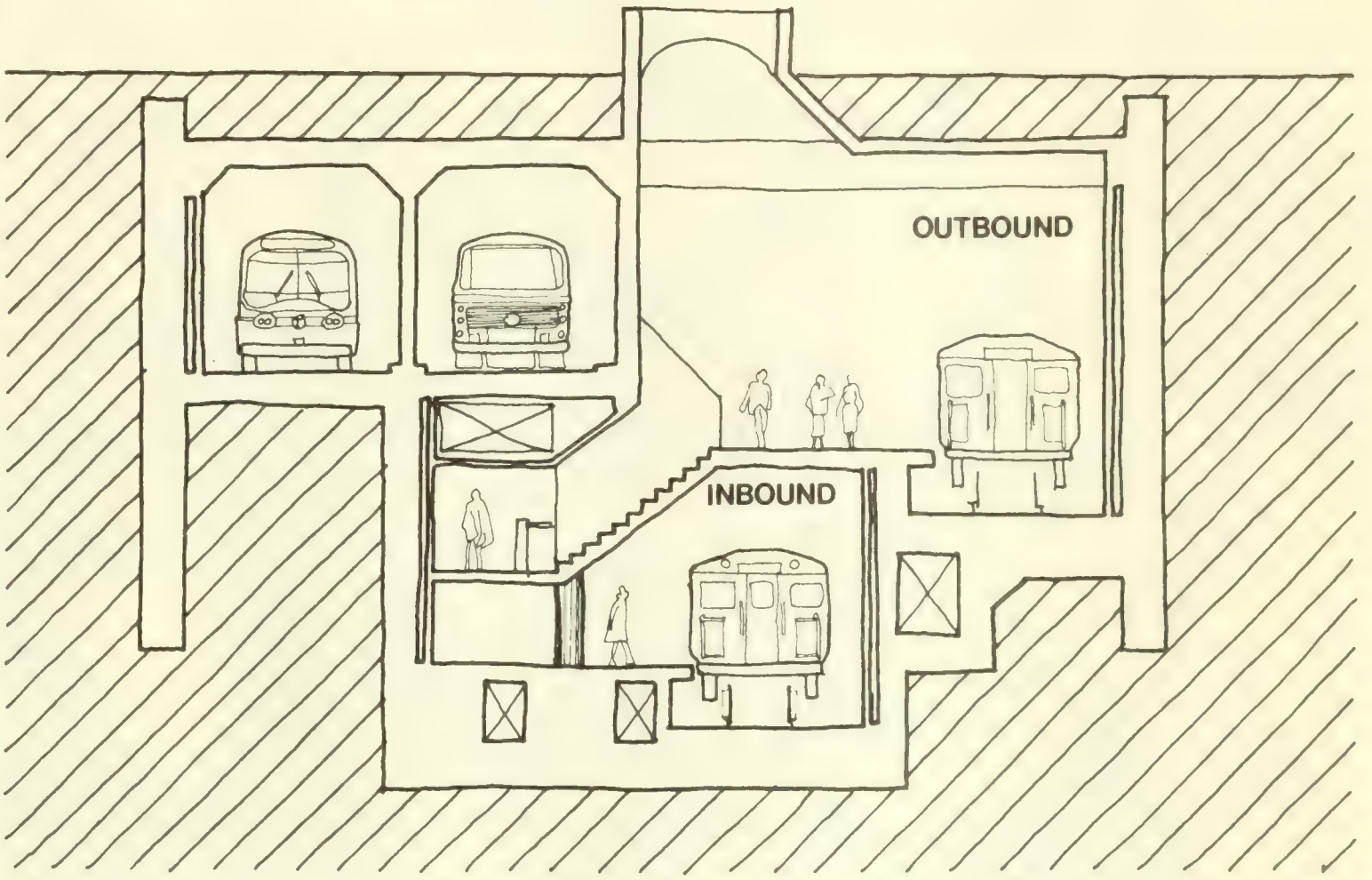
RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

HARVARD SQUARE
EXISTING STATION
INTERIOR VIEWS
FIG. III–8



Source: Skidmore, Owings & Merrill

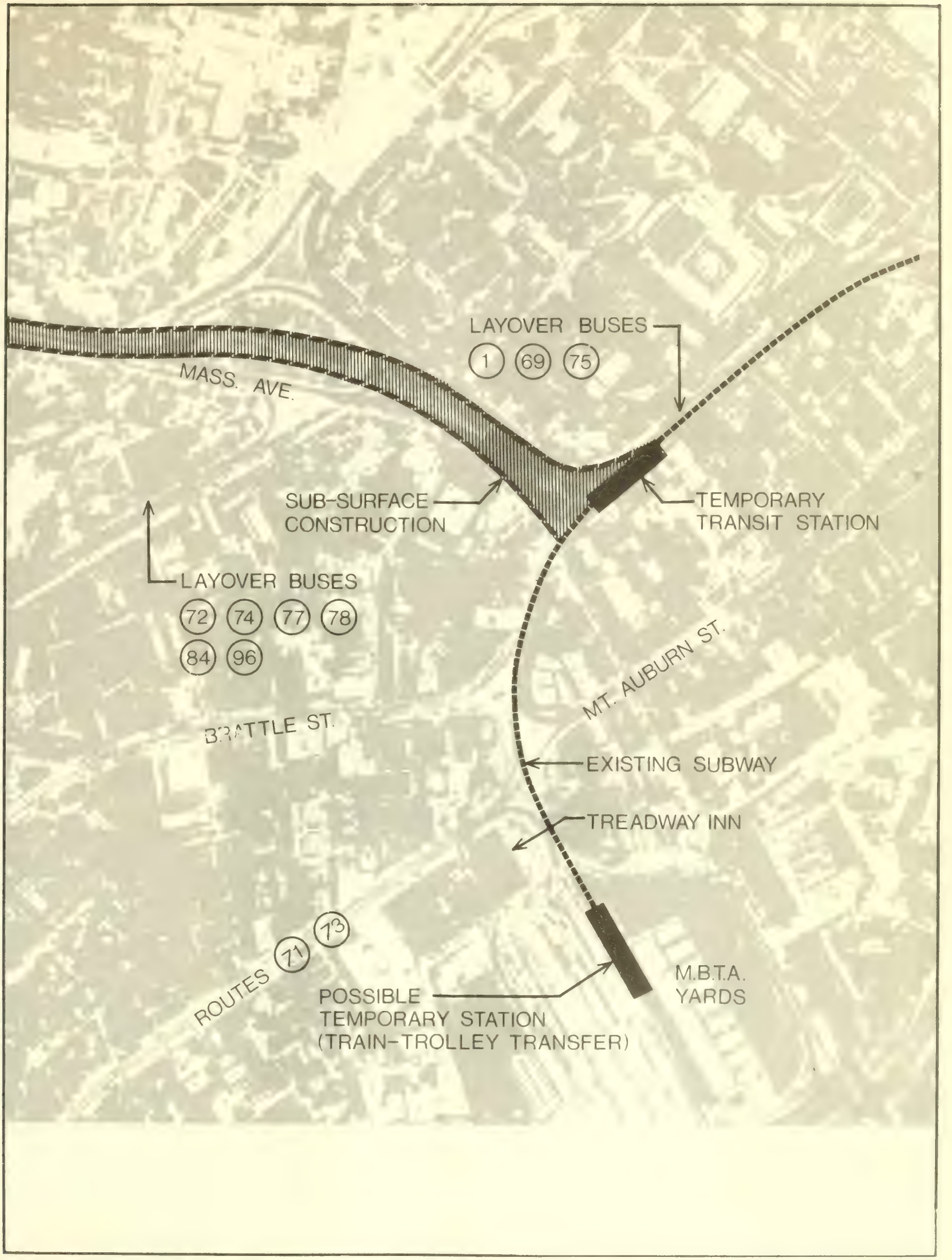
HARVARD SQUARE
STATION PLAN
FIG. III – 9



Source Skidmore, Owings & Merrill

RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

HARVARD SQUARE
CROSS SECTION
FIG. III-10

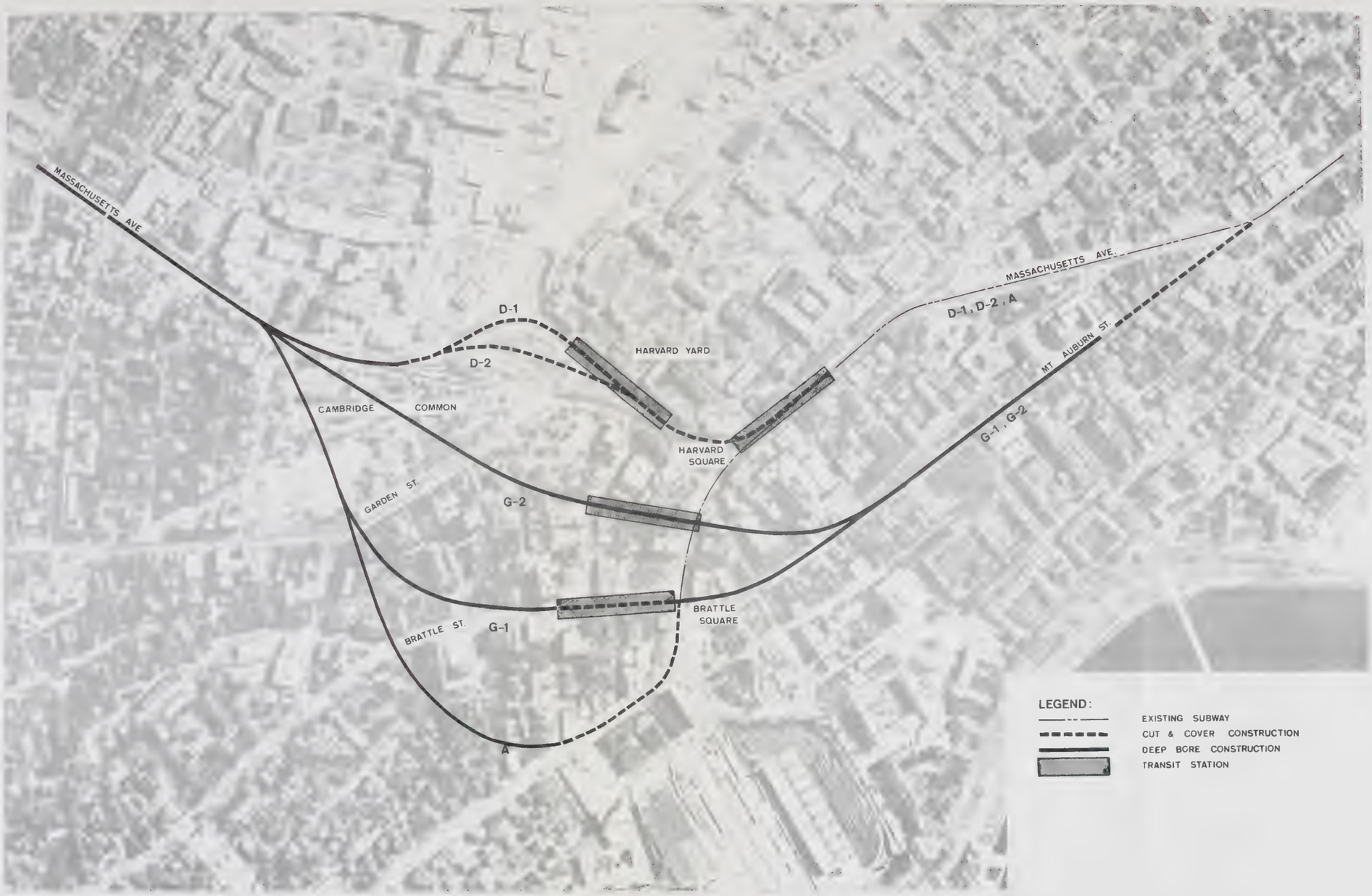


Massachusetts Bay Transportation Authority

HARVARD SQUARE

TEMPORARY TRANSPORTATION FACILITIES DURING CONSTRUCTION

FIG III - 11



RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority
De Leuw, Cather & Company / Sverdrup & Parcel and Associates Inc.

HARVARD SQUARE
ALTERNATIVE ALIGNMENTS

0 100 200 FEET 400

FIG. III-12

SHORT TERM (CONSTRUCTION)	LINE A	LINE D-1 (D-2) PROJECT	LINE G-1	LINE G-2
A. IMPACTS				
1. TRANSIT (RAIL) SERVICE	RAIL SERVICE INTERRUPTED IN MAKING CONNECTION TO EXISTING TRACKS AT BRATTLE SQUARE AND EXTENDING PLATFORMS. WORK COULD BE ACCOMPLISHED DURING OFF-PEAK PERIODS EITHER AT NIGHT OR A WEEKEND. SOME "SLOW DOWN" IN OPERATION FOR ABOUT 8 MONTHS.	PROPER CONSTRUCTION SCHEDULING NECESSARY TO MAINTAIN TWO-TRACK SERVICE. OFF-HOUR WORK WITHIN THE TUNNEL AND TRANSIT SERVICE STOPPAGE LIMITED TO ONE OR TWO WEEKENDS/HOLIDAYS.	RAIL SERVICE INTERRUPTED IN MAKING CONNECTION TO EXISTING TRACKS AT PUTNAM SQUARE: ACCOMPLISHED OFF-PEAK HOURS. SOME DISRUPTION IN THE EXISTING BRATTLE SQUARE TUNNEL BUT SHOULD NOT AFFECT SERVICE.	SAME AS G-1
2. BUS SERVICE	PRESENT LEVEL OF SERVICE CAN BE MAINTAINED. CUT-AND-COVER TUNNEL WORK NEAR THE MT. AUBURN STREET INCLINE WILL CREATE TEMPORARY CONFLICTS.	BUS SERVICE UNDERGROUND CAN BE RETAINED DURING MOST OF CONSTRUCTION PERIOD. NORTHBOUND (UPPER) BUS TUNNEL WILL BE OUT OF USE FOR ABOUT 6 MONTHS AND ALTERNATE ROUTINGS TO OTHER TRANSIT STATIONS AND STOPS WILL BE REQUIRED. PASSENGER STOPS ON THE SURFACE IN HARVARD SQUARE MUST BE RELOCATED TO OTHER AREAS SUCH AS BRATTLE STREET AND CAMBRIDGE COMMON. D-2 IMPACTS ARE SIMILAR EXCEPT BUS TUNNEL USE WOULD BE CURTAILED IN TOTAL FOR ABOUT 12 MONTHS.	MINIMAL INTERFERENCE WITH USE OF BUSWAY TUNNELS. RENOVATION OF EXISTING TUNNEL SPACES WILL CAUSE TEMPORARY INCONVENIENCE TO BUS PASSENGERS. LEVEL OF SERVICE UNAFFECTED.	SAME AS G-1
3. PASSENGER FACILITIES	MINOR INCONVENIENCES TO PASSENGERS DURING STATION MODERNIZATION WORK. PLATFORM EXTENSIONS WILL NOT INTERFERE WITH TRAIN BOARDINGS.	TEMPORARY TWO LEVEL STATION AND KIOSK REQUIRED OPPOSITE EXISTING PLATFORMS. TRANSFER TO BUSSES WOULD BE VIA SURFACE TO EXISTING KIOSK AND DOWN TO BUSWAYS. VARYING ACCESS AND CIRCULATION IMPROVISATIONS THROUGH CONSTRUCTION AREAS WILL CAUSE SOME INCONVENIENCE TO TRAIN/BUS PATRONS.	NO IMPORTANT AFFECT ON EXISTING FUNCTIONS UNTIL NEW STATION IS IN SERVICE. REMODELING OF ABANDONED TUNNELS MAY INCONVENIENCE BUS PASSENGERS.	SAME AS G-1
4. SURFACE TRAFFIC (PEDESTRIAN / VEHICULAR / BICYCLE)	DISRUPTION TO VEHICULAR TRAFFIC IN THE CUT-AND-COVER SECTIONS ON MT. AUBURN ST. BETWEEN HILLIARD ST. AND BRATTLE SQ., AND MASSACHUSETTS AVE. BETWEEN HOLYOKE AND LINDEN STREETS. TWO MOVING LANES CAN BE MAINTAINED WITH NO PARKING. PEDESTRIANS ABLE TO WALK ALONG THE AREA BEING INCONVENIENCED BY WORK. RELOCATION OF KIOSK, IF IMPLEMENTED WILL DISRUPT MASSACHUSETTS AVE. TRAFFIC.	THREE AREAS OF SURFACE CONSTRUCTION AFFECT VEHICULAR MOVEMENT AND PARKING: (1) TEMPORARY STATION (NEAR HOLYOKE CENTER), (2) NEW SUBWAY TUNNEL FROM ABOUT HOLYOKE STREET ALONG HARVARD YARD TO CAMBRIDGE ST. AND MASSACHUSETTS AVE. AT THE COMMON, (3) RESTRUCTURING EXISTING TUNNEL IN KIOSK AREA TO ACCOMMODATE PASSENGER TRANSFER FACILITIES. IT IS PROPOSED TO REROUTE AS MUCH TRAFFIC AS POSSIBLE FROM THE AREA BY USING TRAFFIC ENGINEERING TECHNIQUES SUCH AS ONE-WAY STREETS, INTERSECTION CONTROLS. A MINIMUM OF TWO MOVING TRAFFIC LANES WILL BE MAINTAINED IN HARVARD SQUARE AT ALL TIMES. CONSTRUCTION WILL BE STAGED IN SEGMENTS COMPATIBLE WITH TRAFFIC MOVEMENTS. PEDESTRIAN MOVEMENT ALONG HARVARD YARD WEST FENCE ELIMINATED DURING CONSTRUCTION. PEDESTRIAN MOVEMENT IN THE SQUARE INCONVENIENCED. D-2 SIMILAR EXCEPT NEW BUS TUNNEL BETWEEN CHURCH STREET AND FLAGSTAFF PARK WILL BE BUILT AND SUBWAY WORK WILL BE WITHIN FLAGSTAFF PARK AND NOT ON PEABODY STREET.	TWO MAJOR AREAS OF SURFACE DISRUPTION: (1) BRATTLE STREET BETWEEN THE SQUARE AND STORY STREET. DESIRABLE TO ELIMINATE VEHICULAR TRAFFIC FROM THIS AREA FOR THE CONSTRUCTION PERIOD. PROVISIONS FOR SERVICE VEHICLES AND THE LIKE CAN BE MADE. PEDESTRIAN TRAFFIC INCONVENIENCED BY THE CONSTRUCTION WHICH WILL EXTEND FROM BUILDING LINE TO BUILDING LINE. PEDESTRIAN WAYS, ACCESS TO STORES MAINTAINED THROUGH PROPER PHASING OF THE WORK. (2) FROM PUTNAM SQ. TO ABOUT ATHENS ST. ALONG MT. AUBURN. CUT-AND-COVER WORK IN THIS AREA. ACCESS SHAFT FOR THE DEEP-BORE TUNNEL CONSTRUCTED EAST OF ATHENS ST. THIS REQUIRES CLOSING MT. AUBURN ST. IN THIS AREA FOR THE TOTAL LENGTH OF CONSTRUCTION--APPROXIMATELY 2 YEARS. ISOLATED CONSTRUCTION WORK WHERE BUILDINGS UNDERPINNED. SOME DISRUPTION AROUND THE PARTICULAR STRUCTURE.	THREE AREAS OF DISRUPTION: (1) FROM PUTNAM SQ. TO ABOUT ATHENS ST. ALONG MT. AUBURN ST. CUT-AND-COVER WORK IN THIS AREA. ACCESS SHAFT FOR THE DEEP-BORE TUNNEL CONSTRUCTED EAST OF ATHENS ST. THIS REQUIRES CLOSING MT. AUBURN ST. IN THIS AREA FOR THE TOTAL LENGTH OF CONSTRUCTION--APPROXIMATELY 2 YEARS. (2) PALMER AND BRATTLE STREETS. CONSTRUCTION OF STATION FACILITIES WILL TAKE PLACE OFF THE PAVED STREETS EXCEPT FOR WHATEVER WIDTH OF BRATTLE ST. USED BY CONSTRUCTION EQUIPMENT. (3) CHURCH AND PALMER STREETS, CHURCH ST. GARAGE. THIS LOCATION WILL SERVE AS THE ACCESS SHAFT FOR THE TUNNELING OF THE STATION. ISOLATED CONSTRUCTION WORK WHERE BUILDINGS UNDERPINNED. SOME DISRUPTION AROUND THE PARTICULAR STRUCTURE.
5. SOCIO-ECONOMIC CONDITIONS	SEE MAJOR ISSUES SECTION-THIS BROCHURE			
6. LAND TAKINGS / EASEMENTS	REQUIRES ACQUISITION OF PROPERTY AT 129 MT. AUBURN STREET. PERMANENT EASEMENTS FROM 15 PROPERTIES LOCATED BETWEEN MT. AUBURN STREET AND THE CAMBRIDGE COMMON.	A STRIP OF LAND WILL BE TAKEN FROM HARVARD YARD IN FRONT OF LEHMAN HALL BETWEEN WADSWORTH HOUSE AND STRAUSS HALL.	NO LAND TAKING IS REQUIRED. PERMANENT EASEMENTS REQUIRED FROM 24 PROPERTIES BETWEEN PUTNAM SQ. AND BRATTLE SQ. AND FROM GUTMAN LIBRARY THROUGH RADCLIFFE YARD.	TWO PROPERTIES TAKEN--CHURCH STREET GARAGE AND ZUM-ZUM RESTAURANT AT PALMER AND BRATTLE STREET. PERMANENT EASEMENTS REQUIRED FROM 31 PROPERTIES BETWEEN PUTNAM SQUARE AND THE CAMBRIDGE COMMON.
7. BUILDINGS / RESIDENCES	A NUMBER OF STRUCTURES AFFECTED BY THE CONSTRUCTION. TWO CATEGORIES OF STRUCTURES HAVE BEEN IDENTIFIED (1) MAJOR STRUCTURES REQUIRING UNDERPINNING: IN THIS GROUPING INCLUDES LOEB DRAMA CENTER, SCHLESINGER LIBRARY, FAY HALL, BYERLY HALL (2) MINOR STRUCTURES WHERE UNDERPINNING IS QUESTIONABLE DUE TO THE TYPE OF FOUNDATION AND STRUCTURE; THIS GROUPING INCLUDES WOOD FRAME RESIDENCES ALONG MT. AUBURN STREET (NOS. 131 AND 133), HILLIARD STREET (13, 13-1/2, 15, 17, 18 AND 20) AND FULLER PLACE (55, 56 AND 65) AND BUCKINGHAM. SEE MAJOR ISSUES DISCUSSION.	ALL BUILDINGS ADJACENT TO THE CONSTRUCTION WILL BE PROTECTED TO PREVENT ANY MOVEMENT. STRUCTURES WHERE UNDERPINNING IS QUESTIONABLE INCLUDES EPWORTH CHURCH, ROSCOE POUND BUILDING, WIETH HALL AND EVERETT ST. GARAGE. SEE MAJOR ISSUES DISCUSSION.	A NUMBER OF STRUCTURES AFFECTED BY THE CONSTRUCTION. TWO CATEGORIES OF STRUCTURES HAVE BEEN IDENTIFIED: (1) MAJOR STRUCTURES REQUIRING UNDERPINNING; THIS GROUP INCLUDES ST. PAUL'S CHURCH, LAMPOON BUILDING, THE GARAGE, 1039 MASS. AVE., HOLYOKE CENTER, 95-101 MT. AUBURN ST., 2 MT. AUBURN ST., 25 MT. AUBURN ST., DESIGN RESEARCH, GUTMAN LIBRARY, QUINCY HOUSE DORM, LONGFELLOW HALL, FAY HOUSE, BYERLY HOUSE, 60 BRATTLE ST., and 51 MT. AUBURN ST. (2) MINOR STRUCTURES WHERE UNDERPINNING IS QUESTIONABLE DUE TO THE TYPE OF STRUCTURE AND FOUNDATION, THIS GROUPING INCLUDES 32-36 MT. AUBURN ST., 51-53 MT. AUBURN ST., 62-64 MT. AUBURN ST., 70-72 MT. AUBURN ST., 67-73 MT. AUBURN ST., 82 MT. AUBURN ST., 74-76 MT. AUBURN ST., 52 BRATTLE ST., 54 BRATTLE ST. SEE MAJOR ISSUES DISCUSSION.	A NUMBER OF STRUCTURES AFFECTED BY THE CONSTRUCTION. TWO CATEGORIES OF STRUCTURES HAVE BEEN IDENTIFIED: (1) MAJOR STRUCTURES REQUIRING UNDERPINNING, THIS GROUPING INCLUDES ST. PAUL'S CHURCH, LAMPOON BUILDING, QUINCY HOUSE DORM, 25 MT. AUBURN ST., THE GARAGE, ABBOT BUILDING, 1039 MASS. AVE., HARVARD COOP AND ANNEX, HOLYOKE CENTER, AND 2 MT. AUBURN ST.; (2) MINOR STRUCTURES WHERE UNDERPINNING IS QUESTIONABLE DUE TO THE TYPE OF STRUCTURE AND FOUNDATION, THIS GROUPING INCLUDES CHRIST CHURCH AND RECTORY, 32-36 MT. AUBURN ST., 62-64 MT. AUBURN ST., 70-72 MT. AUBURN ST., 74-76 MT. AUBURN ST., 51-53 MT. AUBURN ST., AND 67-73 MT. AUBURN ST.
8. HISTORIC SITES	TUNNELS CROSS UNDER FAY HOUSE AND BYERLY HOUSE BOTH ARE WITHIN CAMBRIDGE COMMON HISTORICAL DISTRICT--A NATIONAL REGISTER SITE. IT IS PROPOSED TO UNDERPIN THESE STRUCTURES. SEE MAJOR ISSUES DISCUSSION.	LAND TAKEN FROM HARVARD YARD IS WITHIN THE OLD HARVARD YARD HISTORIC DISTRICT-NATIONAL REGISTER OF HISTORIC SITE. THE BRICK WALL IN FRONT OF LEHMAN HALL WILL BE TORN DOWN. THE WALL AND PROPERTY TO BE RESTORED TO EXISTING CONDITION. SEE MAJOR ISSUES DISCUSSION.	TUNNEL CROSSES UNDER FAY HOUSE, BYERLY HOUSE, BOTH WITHIN THE CAMBRIDGE COMMON HISTORICAL DISTRICT. ALSO ADJACENT TO SEVERAL STRUCTURES OF LOCAL HISTORICAL SIGNIFICANCE: ST. PAUL'S CHURCH, LAMPOON BUILDING, LONGFELLOW HALL AND NATIONAL REGISTER SITES: WILLIAM BRATTLE HOUSE AND BRATTLE HALL. SEE MAJOR ISSUES DISCUSSION.	TUNNEL CROSSES UNDER CHRIST CHURCH, OLD BURYING GROUND, BOTH WITHIN THE CAMBRIDGE COMMON HISTORICAL DISTRICT. ALSO ADJACENT TO SEVERAL STRUCTURES OF LOCAL HISTORICAL SIGNIFICANCE: ST. PAUL'S CHURCH, LAMPOON BUILDING, AND 26 CHURCH STREET. SEE MAJOR ISSUES DISCUSSION.
9. RECREATION AREAS	TUNNEL PASSES UNDER THE CAMBRIDGE COMMON. NO SURFACE IMPACT IS ANTICIPATED.	FLAGSTAFF PARK INDIRECTLY AFFECTED BY D-1 ALTERNATE. PROBABLY NEEDED FOR ANCILLARY CONSTRUCTION SPACE. D-2 ALTERNATE INVOLVES CONSTRUCTION IN PARK AREA. PARK CAN BE RESTORED TO PRESENT OR BETTER CONDITION IN EITHER CASE.	TUNNEL PASSES UNDER CAMBRIDGE COMMON AND ADJACENT WINTHROP SQUARE. NO SURFACE IMPACT IS ANTICIPATED.	SAME AS G-1
10. ECOLOGY	NO ECOLOGICAL IMPACT ANTICIPATED. TUNNEL STRUCTURE LOCATED WITHIN CLAY, SAND AND CLAY AND TILL STRATAS, AND BELOW A PERCHED WATER TABLE.	NO ECOLOGICAL IMPACT ANTICIPATED. IT IS OUR UNDERSTANDING THAT TREES IN HARVARD YARD WERE AFFECTED BY DEWATERING FOR THE CONSTRUCTION OF THE EXISTING SUBWAY. DEWATERING FOR PROPOSED CONSTRUCTION WILL BE CLOSELY MONITORED TO MAINTAIN SAFE LEVELS FOR PLANT LIFE IN HARVARD YARD.	SAME AS A	SAME AS A
11. UTILITY SERVICE	THE FOLLOWING UTILITIES ARE TO BE RELOCATED: (1) MT. AUBURN STREET AREA - 12 IN. AND 6 IN. WATERLINE, 8 IN. GAS LINE, 36 IN. MDC SEWER, 19 IN. X 20 IN. COMBINED SEWER, 30 IN. STORM DRAIN, 10 IN. SANITARY SEWER, ELECTRIC DUCTS, (2) MASSACHUSETTS AVENUE - 20 IN. X 24 IN. COMBINED SEWER, 8 IN. WATERLINE AND ELECTRIC DUCTS.	THE FOLLOWING UTILITIES WILL BE RELOCATED: 8 IN., 20 IN., 24 IN. AND 30 IN. WATERLINES, 4 IN., 12 IN. AND 24 IN. GAS LINE, 12 INC. SEWER AND ELECTRIC DUCTS.	THE FOLLOWING UTILITIES ARE TO BE RELOCATED: (1) PUTNAM SQUARE AREA: 24 IN., 12 IN., AND 10 IN. WATERLINES, 8 IN. AND 12 IN. GAS LINES, 15 IN. AND 14 IN. BY 15 IN. SEWER, ELECTRICAL AND TELEPHONE DUCTS; (2) BRATTLE STREET (SQUARE) AREA: 10 IN. WATERLINE, 8 IN. GAS LINE, 10 IN. AND 12 IN. BY 16 IN. SEWER, ELECTRICAL AND TELEPHONE DUCTS.	THE FOLLOWING UTILITIES ARE TO BE RELOCATED IN THE PUTNAM SQUARE AREA: 24 IN., 12 IN. AND 10 IN. WATERLINES, 8 IN. AND 12 IN. GAS LINES, 15 IN. AND 14 IN. X 15 IN. SEWER, ELECTRICAL AND TELEPHONE DUCTS.

SHORT TERM (CONSTRUCTION)	LINE A	LINE D-1 (D-2) PROJECT	LINE G-1	LINE G-2
B. CONSTRUCTION METHODS				
1. CUT-AND-COVER	CUT-AND-COVER WORK WILL BE DONE IN 3 AREAS: (1) MT. AUBURN ST. FROM BRATTLE SQ. TO STORY ST.; (2) NORTH SIDE OF MASS. AVE. BETWEEN LINDEN ST. AND HOLYOKE ST.	CUT-AND-COVER TUNNEL ALONG MASSACHUSETTS AVE. AND PEABODY ST. FROM HOLYOKE ST. TO COMMON AND ALSO AREAS AROUND HARVARD SQ. BETWEEN HARVARD COOP AND LEHMAN HALL. D-2 FLAGSTAFF PARK AREA.	CUT-AND-COVER TUNNEL IN TWO AREAS: (1) FROM PUTNAM SQ. TO MIDWAY BETWEEN ATHENS AND BANKS STREETS ON MT. AUBURN ST., (2) BRATTLE STREET FROM BRATTLE SQUARE TO STORY STREET ALONG BRATTLE STREET.	CUT-AND-COVER TUNNEL FROM PUTNAM SQUARE TO MIDWAY BETWEEN ATHENS AND BANKS STREETS ON MT. AUBURN ST.
2. TUNNELING	DEEP-BORE WILL EXTEND FROM STORY ST. TO PORTER SQ. ACCESS SHAFT AT STORY ST. AND MT. AUBURN ST.	DEEP-BORE TUNNEL FROM THE COMMON AT HEMENWAY GYM TO PORTER SQ. STATION. CONSTRUCTION ACCESS SHAFT LOCATED AT THE PORTER SQ. STATION.	DEEP-BORE TUNNEL FROM ATHENS-BANKS STREET ALONG MT. AUBURN ST. TO BRATTLE SQUARE WITH AN ACCESS SHAFT AT ATHENS-BANKS ST. AND FROM STORY ST. ON BRATTLE ST. TO PORTER SQ. STATION. CONSTRUCTION ACCESS SHAFT LOCATED AT THE PORTER SQ. STATION.	DEEP-BORE TUNNEL FROM ATHENS-BANKS STREET TO PORTER SQUARE STATION. ACCESS CONSTRUCTION SHAFTS LOCATED AT ATHENS AND BANKS ST., CHURCH ST. GARAGE, AND PORTER SQUARE STATION.
3. LENGTH OF CONSTRUCTION	RAPID TRANSIT TUNNELS--22 MONTHS ASSUMING CONCURRENT WORK IN VARIOUS AREAS. STATION REVISIONS--8 MONTHS. NO BUSWAY WORK IS REQUIRED.	RAPID TRANSIT TUNNELS - 20 MONTHS ASSUMING CONCURRENT WORK IN VARIOUS AREAS. NEW STATION - 20 MONTHS. REVISIONS TO BUS TUNNEL - 6 MONTHS. (D-2) RAPID TRANSIT TUNNELS - 28 MONTHS; NEW STATION - 28 MONTHS; NEW BUS TUNNEL - 12 MONTHS.	RAPID TRANSIT TUNNELS - 24 MONTHS ASSUMING CONCURRENT WORK IN VARIOUS AREAS. NEW STATION - 18 MONTHS. MINOR REVISIONS TO BUS TUNNEL - 3 MONTHS.	RAPID TRANSIT TUNNELS - 24 MONTHS ASSUMING CONCURRENT WORK IN VARIOUS AREAS. NEW STATION - 18 MONTHS. MINOR REVISIONS TO BUS TUNNEL - 3 MONTHS.
4. CONSTRUCTION DIFFICULTY	NOT AS DIFFICULT AS LINE G-1; MORE DIFFICULT THAN D-1 OR D-2. DIFFICULTY CREATED BY TUNNELING UNDER BUILDINGS.	LEAST DIFFICULT TO CONSTRUCT BECAUSE OF PREDOMINANCE OF CUT-AND-COVER WORK.	NOT AS DIFFICULT AS LINE G-2; MORE DIFFICULT THAN LINE A. TUNNEL UNDER AND ADJACENT BUILDINGS, TUNNEL PROFILE PARTLY IN ROCK, PARTLY IN SOIL PRODUCING AN UNDESIRABLE MIXED-FACE TUNNELING SITUATION.	THE MOST DIFFICULT TO CONSTRUCT. TUNNELING UNDER AND ADJACENT BUILDINGS; TUNNEL PROFILE PARTLY IN ROCK, PARTLY IN SOIL PRODUCING AN UNDESIRABLE MIXED-FACE TUNNELING SITUATION; LARGE DIAMETER TUNNELING SHIELD REQUIRED FOR STATION TUNNELS.
PROJECT COSTS				
A. TOTAL CONSTRUCTION COSTS	$44,000,000	D-1 $32,000,000 D-2 $35,000,000	$74,000,000	$79,000,000
B. OPERATION COSTS DURING CONSTRUCTION	$89,000	$121,000	$34,000	$34,000
C. INCREMENTAL OPERATIONS COSTS PER YEAR	$146,000	$163,000	$136,000	$139,000
CONTRACTURAL REQUIREMENTS				
A. BUS TUNNEL CONNECTING MASS. AVENUE AND MT. AUBURN ST.	EXISTING BUS TUNNEL REMAINS.	EXISTING BUS TUNNEL REMAINS.	EXISTING BUS TUNNEL REMAINS.	EXISTING BUS TUNNEL REMAINS.
B. MAINTAIN PRESENT LEVEL OF TRANSIT SERVICE DURING CONSTRUCTION	SERVICE MAINTAINED WITH MINOR INTERFERENCE.	SERVICE MAINTAINED TO A DEGREE. SOME BUS LINES TO BE REROUTED TO OTHER TRANSIT STATIONS. TEMPORARY TRANSIT STATION WILL CAUSE SOME INCONVENIENCE TO PASSENGERS. BUS STOPS ON MASSACHUSETTS AVE. NEAR HARVARD YARD ELIMINATED.	SERVICE MAINTAINED WITH MINOR INTERFERENCE.	SERVICE MAINTAINED WITH MINOR INTERFERENCE.
C. PROVIDE ACCESS FROM BRATTLE SQUARE TO STATION	NO ACCESS FROM BRATTLE SQUARE.	CAN BE PROVIDED IN ABANDONED EXISTING TUNNEL.	STATION ENTRANCE IN BRATTLE SQUARE.	CAN BE PROVIDED IN ABANDONED EXISTING TUNNEL.
D. AVOID SEVERE SURFACE DISRUPTION DURING CONSTRUCTION	DISRUPTION MINIMIZED THROUGH USE OF TRAFFIC REROUTINGS, DECKING-OVER OF EXCAVATIONS, PARKING RESTRICTIONS.	SAME AS A	SAME AS A	SAME AS A
E. TURNBACK & STORAGE FACILITIES	EXISTING FACILITIES MAINTAINED.	ABANDONED TUNNEL COULD BE USED.	PORTIONS OF ABANDONED TUNNEL COULD BE USED.	PORTIONS OF ABANDONED TUNNEL COULD BE USED.

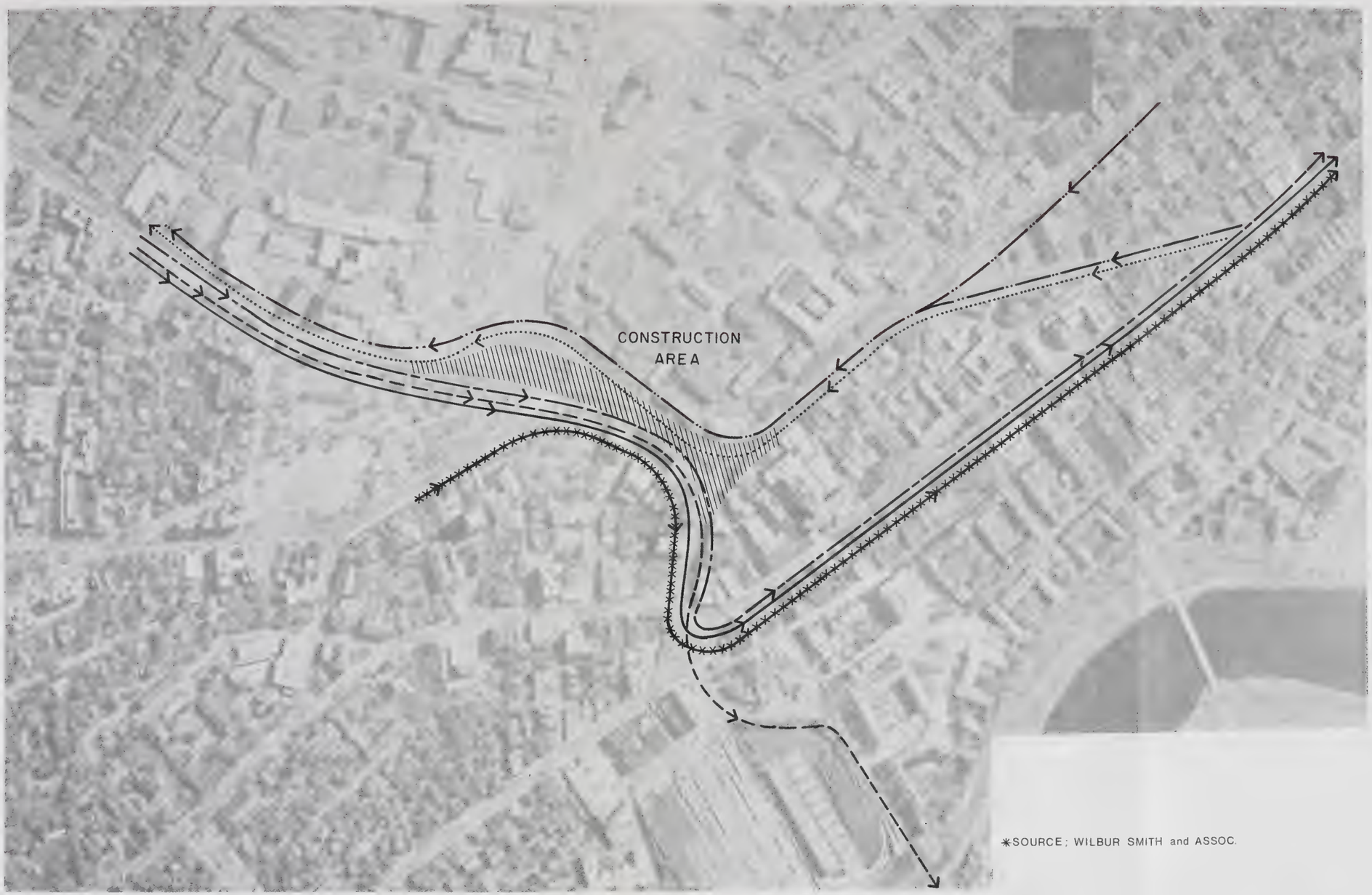
LONG TERM (OPERATIONAL)	LINE A	LINE D-1 (D-2) PROJECT	LINE G-1	LINE G-2
A. RAPID TRANSIT CRITERIA				
1. GEOMETRICS	CURVES RANGING FROM 320 FT. TO 480 FT. RADII ARE BELOW DESIRABLE STANDARDS (500' MIN. RADIUS)--INCREASES TRACK MAINTENANCE, AND RESTRICTS OPERATING SPEEDS. GRADE IS SLIGHTLY STEEPER THAN DESIRABLE 3%. DEFINITE WHEEL SQUEAL AT HARVARD SQUARE, ELIOT SQUARE AND HILLIARD ST., BUT INTENSITY CAN BE CONTROLLED.	D-1 ALIGNMENT REQUIRES CURVES OF 250 FT. AND 450 FT. RADII--ALL BELOW DESIRABLE STANDARD OF 500 FT. MIN. RADIUS--INCREASES TRACK MAINTENANCE AND RESTRICTS OPERATING SPEEDS. STATION IS ON 1/2% GRADE VS. DESIRABLE LEVEL PROFILE. DEFINITE WHEEL SQUEAL AT HARVARD SQUARE AND FLAGSTAFF PARK, BUT INTENSITY CAN BE CONTROLLED. D-2 IS SIMILAR BUT FLATTER CURVES NORTH OF STATION IMPROVES GEOMETRICS.	FAIRLY "SMOOTH" ALIGNMENT. NO SUBSTANDARD CURVES OR GRADES, BUT CURVES WILL RESTRICT OPERATING SPEEDS. WHEEL SQUEAL IS PROBABLE AT EACH END OF STATION BUT INTENSITY CAN BE CONTROLLED.	BEST GEOMETRY OF ALTERNATIVES STUDIED. NO SUBSTANDARD CURVES OR GRADES. AFFECT ON OPERATING SPEED IS MINIMAL. POSSIBLE WHEEL SQUEAL EACH END OF STATION BUT INTENSITY CAN BE CONTROLLED.
2. RUNNING TIME (CENTRAL SQ.) (TO) (PORTER SQ.)	4 MINUTES 40 SECONDS	4 MINUTES 23 SECONDS (D-1) 4 MINUTES 17 SECONDS (D-2)	4 MINUTES 17 SECONDS	4 MINUTES 0 SECONDS
3. INTERFACE WITH BUS SERVICE	EXISTING UNDERGROUND ARRANGEMENT UNCHANGED. INTERCONNECTION IS GENERALLY DIRECT BUT SPATIALLY CONFUSING.	EXISTING UNDERGROUND BUSWAYS USED. (WAITING SPACES MODIFIED.) BUS PASSENGER AREAS ARE PHYSICALLY AND VISUALLY INTEGRATED WITH TRANSIT MEZZANINE LEVELS. MOST DIRECT RELATIONSHIP OF STATION ALTERNATES STUDIED.	COMPARABLE TO G-2. HORIZONTAL DISTANCES BETWEEN TRANSIT MODES ARE SOMEWHAT GREATER BUT VERTICAL DISTANCES ARE LESS.	EXISTING UNDERGROUND BUSWAYS USED. (WAITING SPACES MODIFIED AND CENTERED NEAR PALMER STREET.) ADJOINING TUNNEL SPACE FROM KIOSK AREA TO BRATTLE SQ. BECOMES "FREE" CONCOURSE. CONCEPT REQUIRES TWO OR MORE VERTICAL MOVEMENTS TO REACH TRAIN LEVEL FROM BUS AREAS, BUT MOVEMENTS ARE UNCOMPLICATED.
4. CROSSOVER PROVISIONS	EXISTING CROSSOVER PROVISIONS RETAINED.	CROSSOVER PROVIDED NORTH OF NEW STATION.	CROSSOVER FEASIBLE BUT NOT PLANNED. WOULD REQUIRE ADDITIONAL CUT-AND-COVER WORK TO GUTMAN LIBRARY.	NONE PLANNED. IMPRACTICAL IN DEEP-BORE CONSTRUCTION.
5. TRAIN STORAGE	CAN BE IN EXISTING TUNNEL FROM BRATTLE SQUARE TO ELIOT YARD PORTAL.	INBOUND TRACK CONNECTION TO EXISTING TUNNEL WEST OF HARVARD SQUARE REMAINS. TUNNEL COULD BE UTILIZED FOR TRAIN STORAGE.	BOTH TRACKS COULD MAINTAIN DIRECT CONNECTION TO EXISTING TRANSIT AT PUTNAM SQUARE. POSSIBLE TO USE THIS TUNNEL FOR TRAIN STORAGE.	SAME AS G-1
6. LAYUP TRACK	CAN BE IN EXISTING TUNNEL FROM BRATTLE SQUARE TO ELIOT YARD PORTAL.	USE OF ONE TRACK IN ABANDONED TUNNEL IS PROPOSED. A LAY-UP TRACK NORTH OF STATION IS PREFERABLE BUT IS NOT PLANNED.	POSSIBLE TO USE ABANDONED TRACKAGE WEST OF PUTNAM SQUARE. A LAYUP TRACK NORTH OF STATION IS PREFERABLE BUT IS NOT PLANNED.	SAME AS G-1
B. BUS SERVICE				
1. THROUGH ROUTES AND TERMINUS ROUTES	TRANSIT EXTENSION WILL REDUCE DAILY BUS VOLUME BY ABOUT 50%. THROUGH-ROUTING OF ALL LINES, WITH NO HOLDOVER, IS PROPOSED. THE EXCEPTION IS THE DUDLEY STATION ROUTE WHICH WILL TERMINATE AND RETURN.	SAME AS A	SAME AS A	SAME AS A
C. PASSENGER POTENTIAL				
1. RAPID TRANSIT STATION / BUS PLATFORM	CLOSE TO CENTERS OF PROJECTED EMPLOYMENT AND RESIDENT POPULATION WITHIN A 1/2 MILE RADIUS.	CLOSE TO CENTERS OF PROJECTED EMPLOYMENT AND 1/2 MILE POPULATION RADIUS.	CLOSEST TO PROJECTED EMPLOYMENT CENTER AND 1/4 MILE POPULATION CENTER.	CLOSEST TO CENTER OF COMMERCIAL FLOOR SPACE AND PROJECTED 1/4 MILE POPULATION RADIUS.
D. IMPACTS				
1. SURFACE TRAFFIC (PEDESTRIAN, VEHICULAR, BICYCLE)	MAIN ENTRANCE MUST REMAIN AT OR NEAR PRESENT LOCATION. PEDESTRIAN-VEHICULAR CONFLICT COULD BE REDUCED BY MODIFYING STREET PATTERNS AND ANNEXING ENTRANCE TO EITHER THE SOUTH OR WEST SIDES OF THE SQUARE. CONSIDERABLE STREET AREA COULD THEREBY CONVERT TO PEDESTRIAN SPACE.	EXISTING KIOSK AND ISLAND CAN BE ELIMINATED. ENTRANCES IN HARVARD SQUARE ARE POSSIBLE AT PERIPHERAL LOCATIONS AND IN BRATTLE STREET (NEAR PALMER). MODIFIED TRAFFIC PATTERNS AND ENLARGED PEDESTRIAN AREAS ARE NEEDED FOR OPTIMUM EFFECTIVENESS.	TWO OR MORE ENTRANCES REQUIRED ALONG HARVARD SQUARE-BRATTLE SQUARE AXIS. ACCESS LOCATIONS ARE ADAPTABLE TO PRESENT TRAFFIC PATTERNS (WITH SOME MODIFICATION OF CURB LINES), BUT CLOSING OF BRATTLE STREET FROM CHURCH STREET TO KIOSK AREA WOULD PROVIDE BETTER DESIGN OPTIONS ABOVE AND BELOW GROUND.	SAME AS G-1, EXCEPT MAIN ENTRANCE WOULD BE OFF-STREET (CORNER OF BRATTLE AND PALMER STREET).
2. SOCIO-ECONOMIC CONDITIONS	SEE CHAPTER V			
3. BUILDINGS / RESIDENCES	LINE CROSSES UNDER OR ADJACENT SENSITIVE BUILDINGS SUCH AS HARVARD DORMS ALONG MASSACHUSETTS AVE., HILLIARD ST. RESIDENCES, LOEB DRAMA CENTER, RADCLIFFE YARD BUILDINGS AND EPWORTH CHURCH. EXTENSIVE NOISE AND VIBRATION CONTROLS ARE NECESSARY.	LINE IS ADJACENT TO SEVERAL SENSITIVE BUILDINGS SUCH AS HARVARD DORMS ALONG MASSACHUSETTS AVE. AND PEABODY ST., THE LITTAUER CENTER, GANNETT HOUSE, EPWORTH CHURCH, AND THE UNITARIAN CHURCH. INTERMEDIATE NOISE AND VIBRATION CONTROLS ARE NECESSARY BUT LEAST OF ALTERNATES STUDIED.	LINE CROSSES UNDER OR ADJACENT SENSITIVE BUILDINGS SUCH AS ST. PAUL'S CHURCH, BRATTLE THEATER AREA, LOEB DRAMA CENTER, RADCLIFFE YARD BUILDINGS, GUTMAN LIBRARY, AND EPWORTH CHURCH. EXTENSIVE NOISE AND VIBRATION CONTROLS ARE NECESSARY.	LINE CROSSES UNDER OR ADJACENT SENSITIVE BUILDINGS SUCH AS ST. PAUL'S CHURCH, CHRIST CHURCH AND EPWORTH CHURCH. INTERMEDIATE NOISE AND VIBRATION CONTROLS ARE NECESSARY.
4. HISTORIC SITES	ALIGNMENT CROSSES UNDER FAY HOUSE AND BYERLY HALL BOTH WITHIN THE CAMBRIDGE COMMON HISTORIC DISTRICT/NATIONAL REGISTER OF HISTORIC PLACES. EXTENSIVE NOISE AND VIBRATION CONTROLS ARE NECESSARY TO NEGATE IMPACTS.	ALIGNMENT IS WITHIN THE CAMBRIDGE COMMON HISTORIC DISTRICT, AND ADJACENT TO THE OLD HARVARD YARD HISTORIC DISTRICT, BOTH ON THE NATIONAL HISTORIC REGISTER. INTERMEDIATE NOISE AND VIBRATION CONTROLS ARE NECESSARY.	ALIGNMENT CROSSES UNDER FAY HOUSE AND BYERLY HALL BOTH WITHIN THE CAMBRIDGE COMMON HISTORIC DISTRICT/NATIONAL REGISTER OF HISTORIC PLACES AND ADJACENT TO OTHER NATIONAL HISTORIC SITES AS THE WILLIAM BRATTLE HOUSE AND THE VILLAGE BLACKSMITH. SEVERAL SITES OF LOCAL HISTORICAL SIGNIFICANCE SUCH AS ST. PAUL'S CHURCH, LAMPOON BUILDING AND LONGFELLOW HALL ADJACENT TO THE ALIGNMENT. EXTENSIVE NOISE AND VIBRATION CONTROLS ARE NECESSARY.	ALIGNMENT CROSSES UNDER CHRIST CHURCH WHICH IS WITHIN THE CAMBRIDGE COMMON HISTORIC DISTRICT/NATIONAL REGISTER OF HISTORIC PLACES. SEVERAL SITES OF LOCAL SIGNIFICANCE ADJACENT TO ALIGNMENT SUCH AS ST. PAUL'S CHURCH, LAMPOON BUILDING, 31 CHURCH STREET (FORMER POLICE STATION) AND 26 CHURCH STREET. INTERMEDIATE NOISE AND VIBRATION CONTROLS ARE NECESSARY.
5. RECREATION AREAS	ALIGNMENT CROSSES UNDER CAMBRIDGE COMMON. NO ADVERSE IMPACT IS ANTICIPATED.	AN EMERGENCY EXIT PRESENTLY CONTEMPLATED WITHIN FLAGSTAFF PARK. POTENTIAL FOR COMBINED EAST-WEST BUS STOP AND TRANSIT ENTRANCE.	THE ALIGNMENT CROSSES UNDER CAMBRIDGE COMMON AND ADJACENT TO WINTHROP SQUARE. NO ADVERSE IMPACT IS ANTICIPATED.	ALIGNMENT CROSSES UNDER CAMBRIDGE COMMON. NO ADVERSE IMPACT IS ANTICIPATED.
6. ECOLOGY	NO ADVERSE ECOLOGIC IMPACT IS ANTICIPATED.	LOSS OF TREES IN FLAGSTAFF PARK UNDER D-2	SAME AS A	SAME AS A

*SOURCE; WILBUR SMITH and ASSOC

RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

HARVARD SQUARE
EXISTING STREET DIRECTIONS, PARKING RESTRICTIONS AND TRAFFIC CONTROL DEVICES

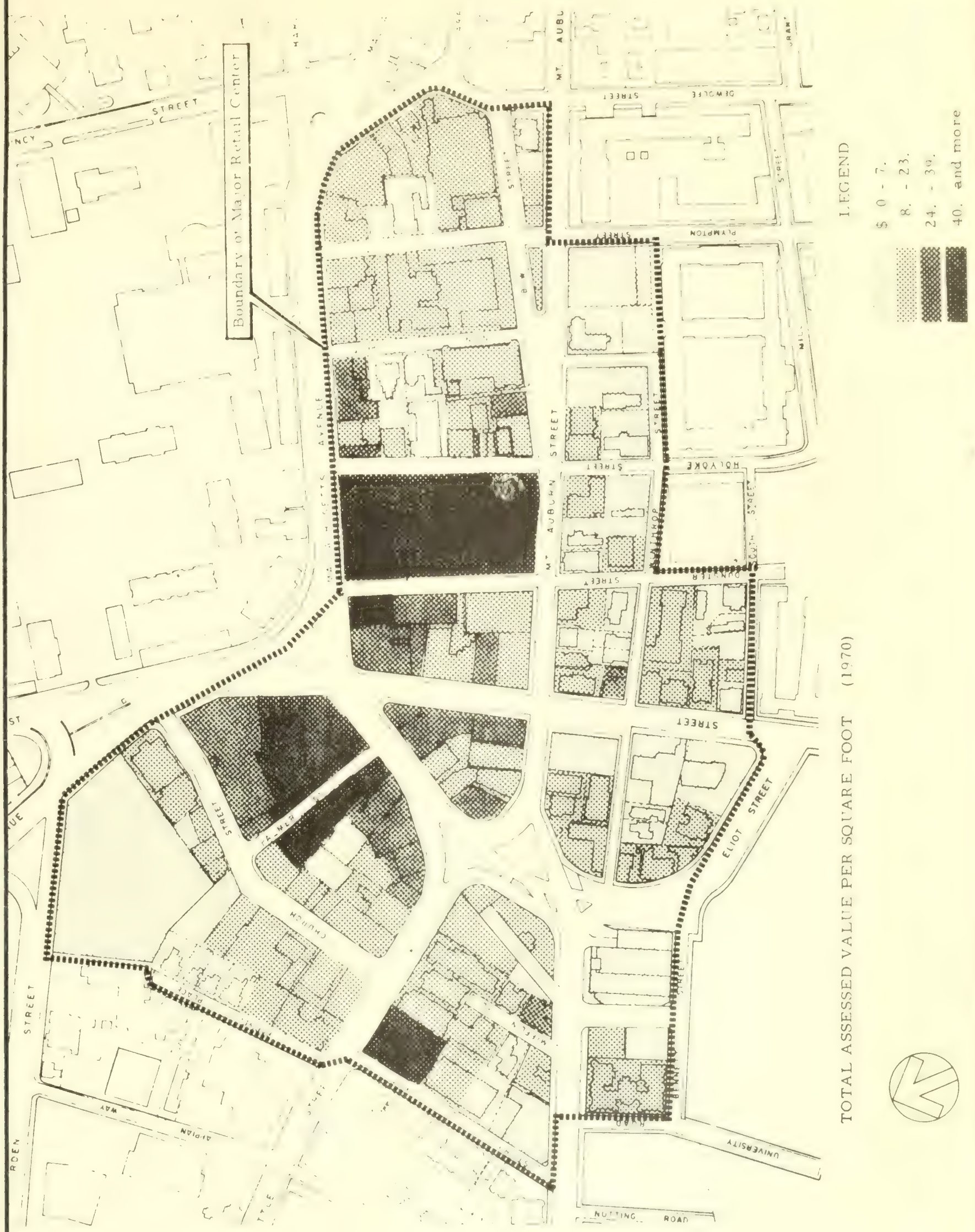
FIG III-14



*SOURCE; WILBUR SMITH and ASSOC.

RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

HARVARD SQUARE
EXISTING TRAFFIC ROUTING
AFFECTED BY CONSTRUCTION
FIG III-15



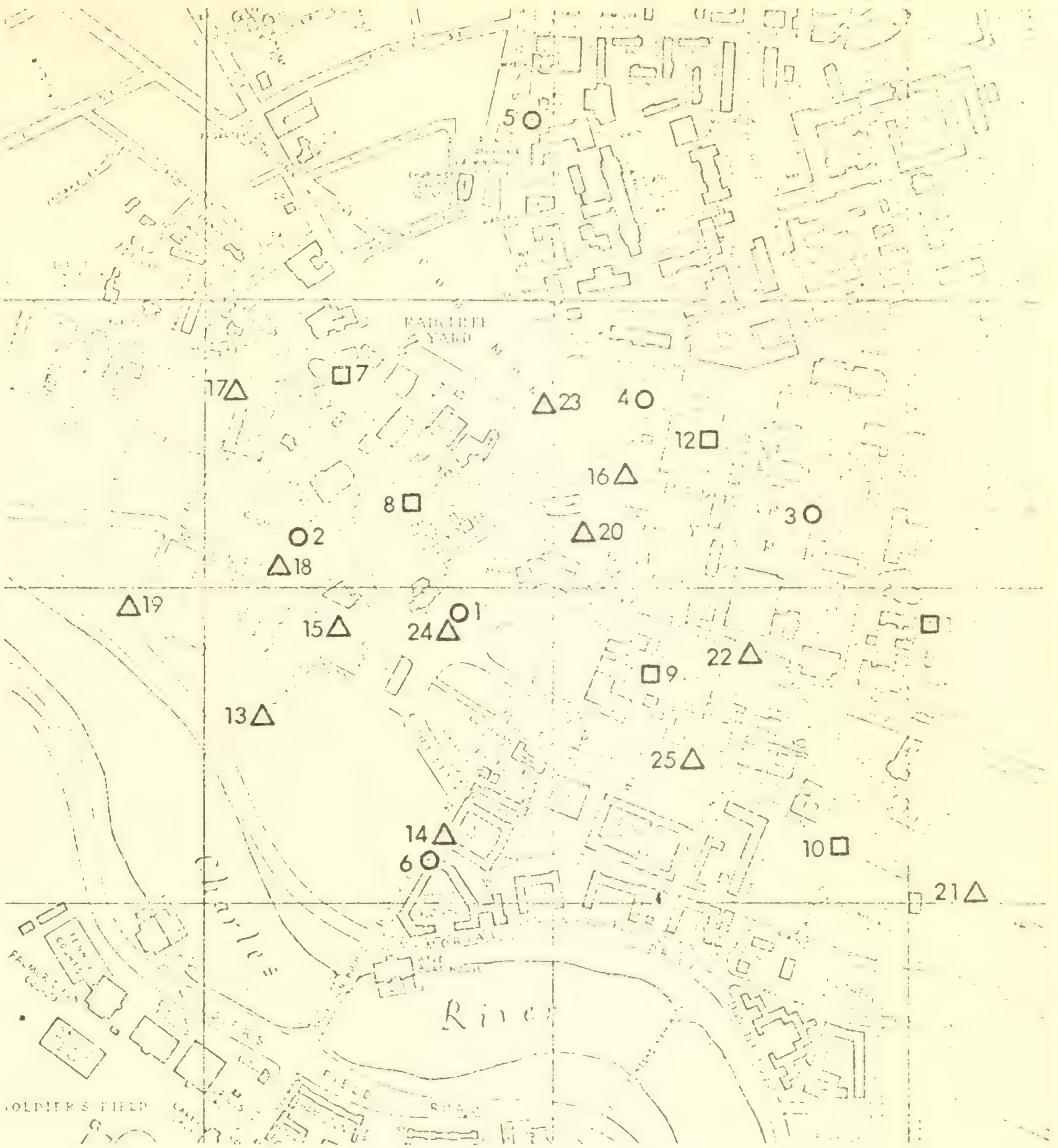
1970

Massachusetts Bay Transportation Authority

HARVARD SQUARE

ASSESSED EVALUATION OF HARVARD SQ. PROPERTY

FIG III-16



SITES

- ○ 24 HOUR*
- □ SHORT TERM*
- △ JFK EIS

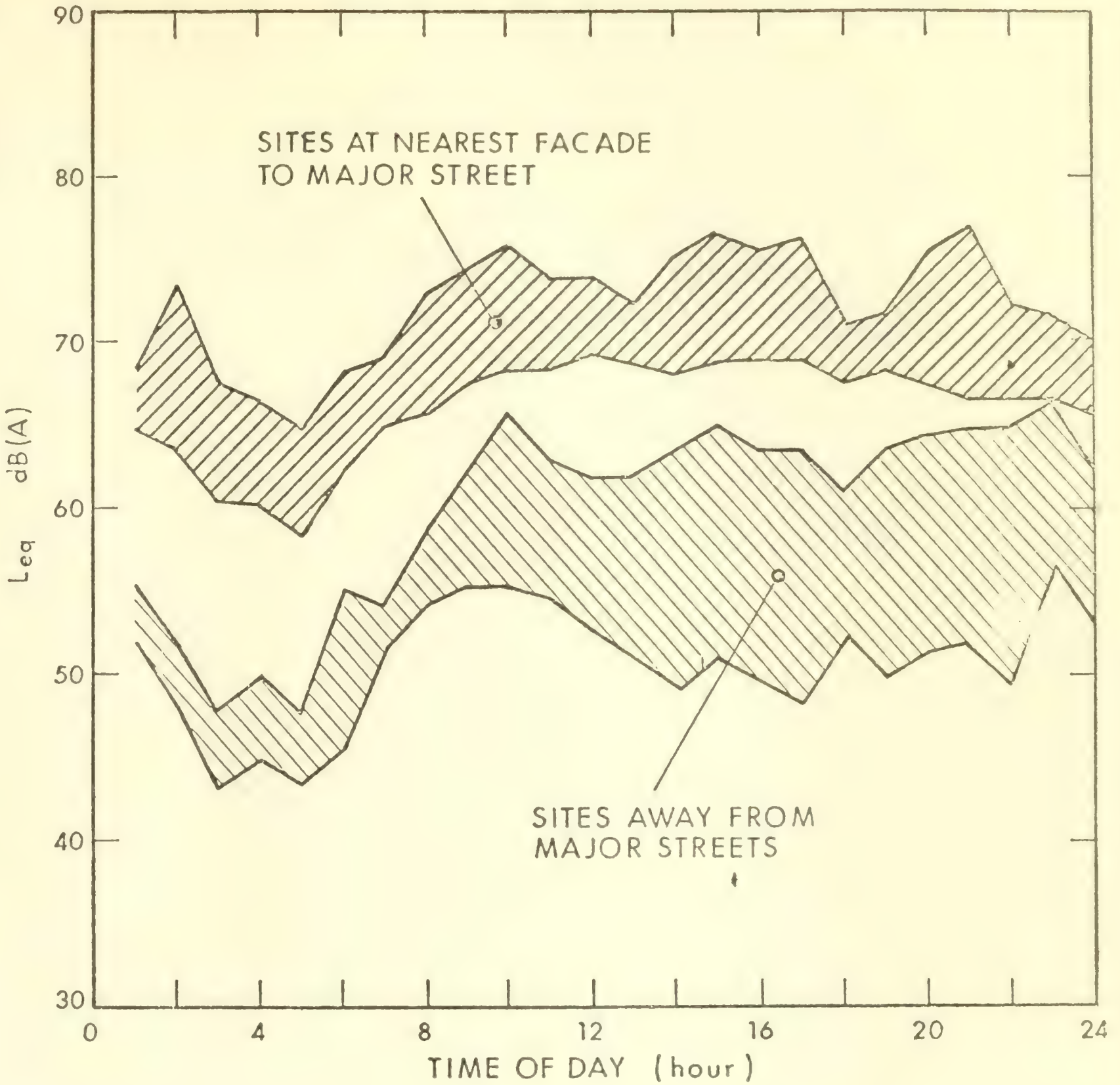
*SOURCE:

BOLT, BERANEK AND NEWMAN
NOISE MEASUREMENT SURVEY, 1974

RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

HARVARD SQUARE

AMBIENT NOISE
MEASUREMENT SITES
FIG III-17

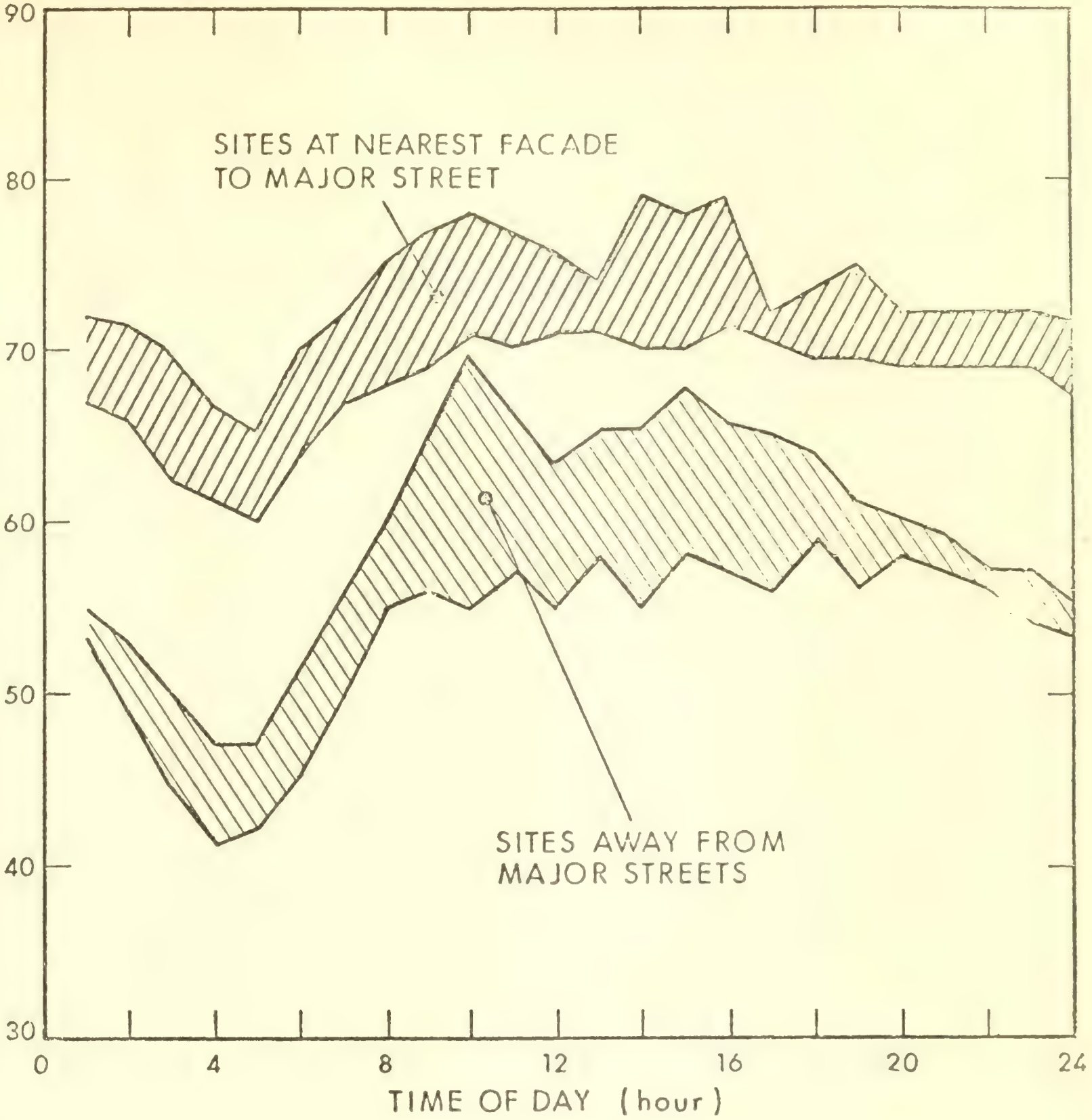


HOURLY VARIATION IN L_{eq} NOISE LEVELS AT THE
24-HOUR NOISE MEASUREMENT SITES

RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

HARVARD SQUARE
NOISE MEASUREMENTS

FIG III-18

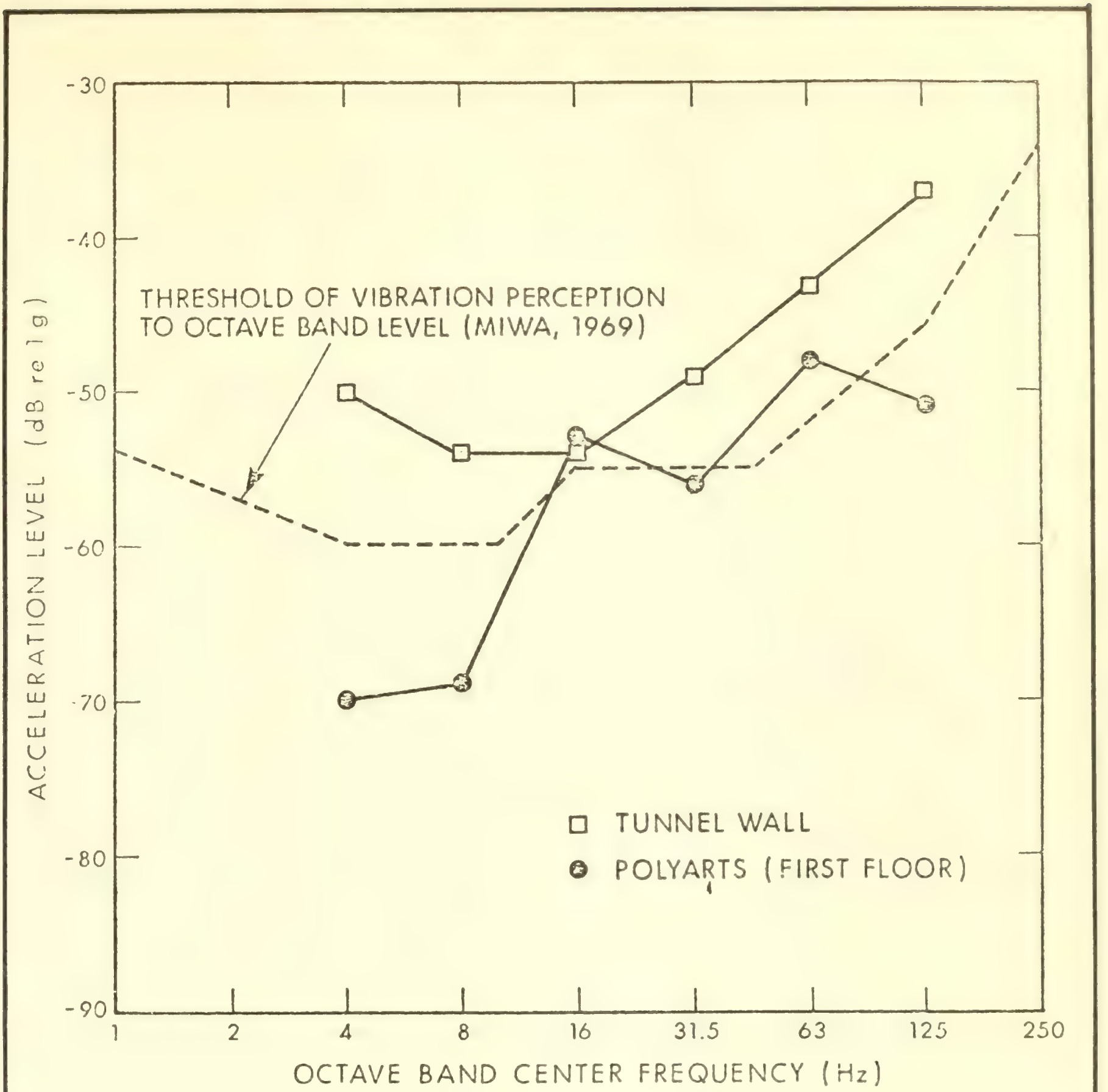


HOURLY VARIATION IN L_{10} NOISE LEVELS AT THE
24-HOUR NOISE MEASUREMENT SITES

RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

HARVARD SQUARE
NOISE MEASUREMENTS

FIG III-19

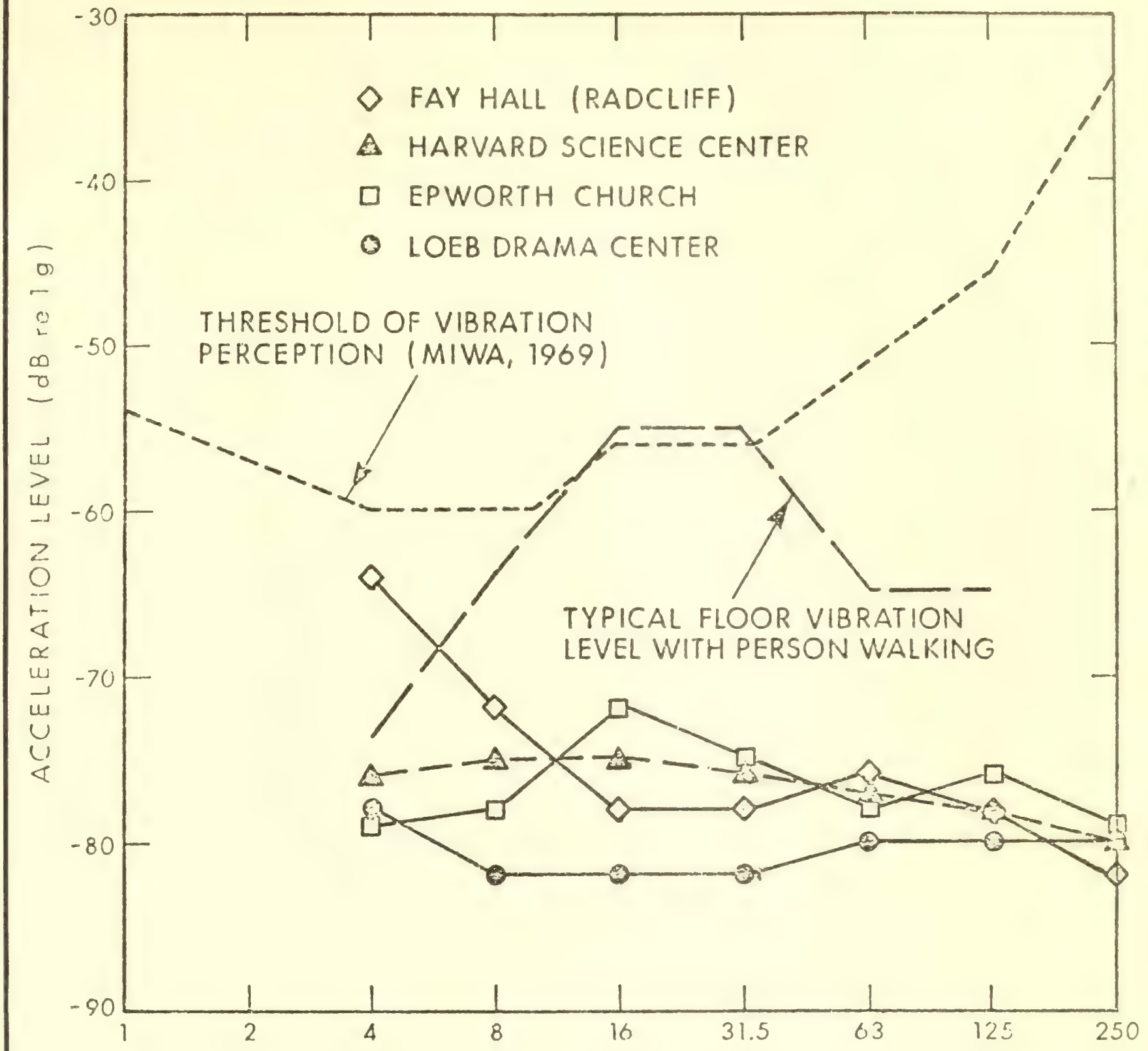


SUBWAY TUNNEL WALL AND NEARBY BUILDING
FLOOR VIBRATION LEVELS

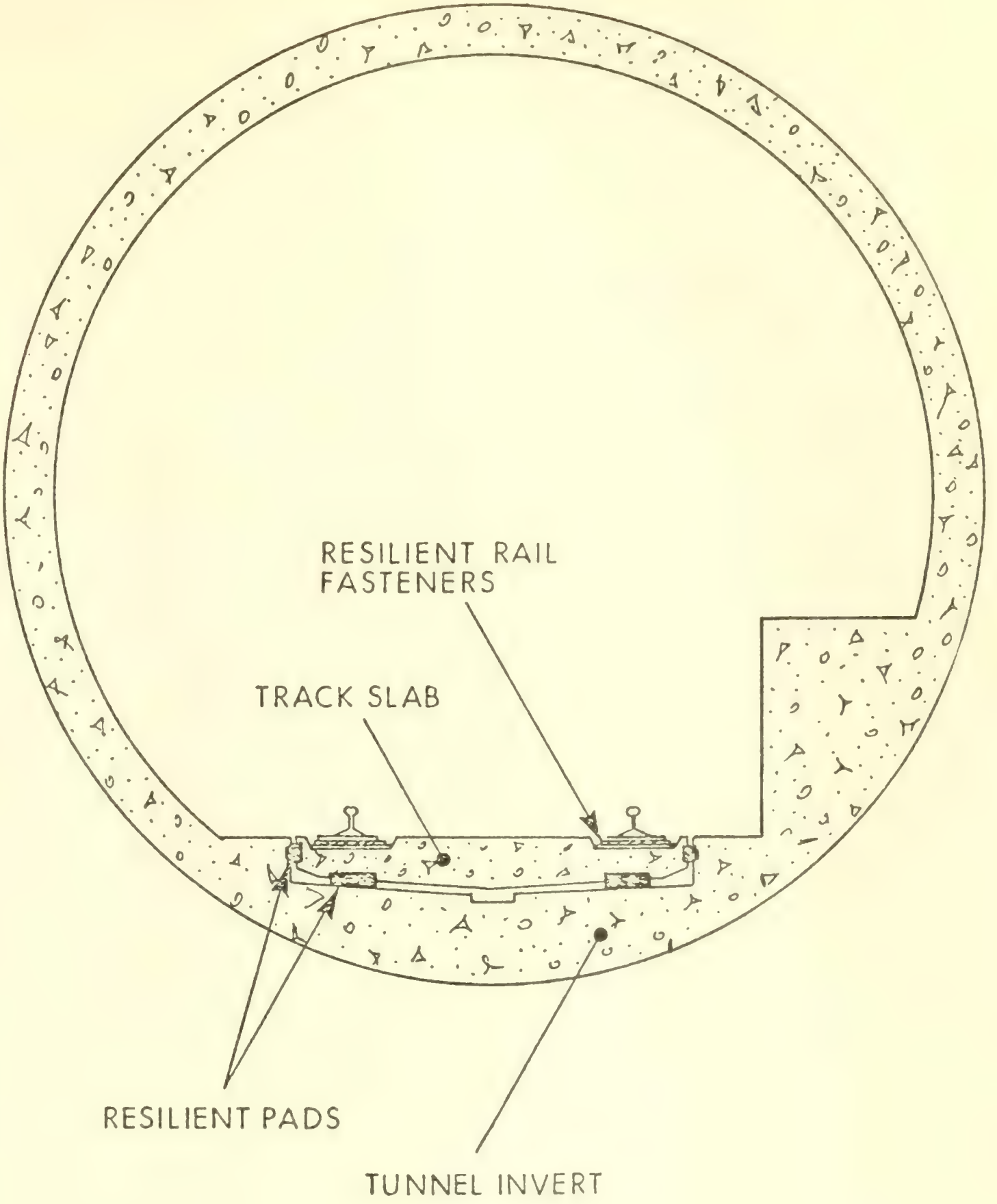
RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

HARVARD SQUARE
VIBRATION LEVELS

FIG III-20



VIBRATION LEVELS IN BUILDINGS NEAR THE PROPOSED EXTENSION ALIGNMENTS



RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

HARVARD SQUARE
FLOATING SLAB
TRACK BED
FIG III - 22

Chapter IV

HARVARD SQUARE TO PORTER SQUARE

Chapter IV

HARVARD SQUARE TO PORTER SQUARE

PROJECT DESCRIPTION

The alignment recommended for the Harvard Square-Porter Square Section of the proposed Red Line Extension consists of a 4,400-foot tunneled line segment and a station at Porter Square. Constructed primarily under Massachusetts Avenue, the segment would extend north from Harvard Square in a tunnel/deep bore (two 20-foot-diameter tubes) to the proposed location of the station below the commuter rail station in the Porter Square business district. The Porter Square station would be a deep station constructed by mining methods. Two ventilation and emergency shafts would be provided. The costs have been estimated at approximately $77,921,000 for the line segment and $44,640,000 for the station, for a combined cost of approximately $122,561,000.

The BTPR Study, which was conducted in 1973, suggested an alignment from Harvard Square to Porter Square but did not consider the Harvard Square Area. The alignment proposed in this report resulted from investigations to determine the optimum location for the new Harvard Square Station and, therefore, differs somewhat from that proposed by the BTPR. From about Waterhouse Street northward, however, the two alignments are quite similar.

Line Segment

From the Flagstaff Park end of the new Harvard Square Station, the extension would proceed northwardly on a slight "S" curve to about Everett Street. From that point until it reaches the Porter Square Station, the segment would be on a tangent to Lancaster Street. A slight "S" curve follows from this point to the Porter Station. The alignment crosses under Cambridge Common and North Little Common.

In Figure II-1 B & C, the centerline curves are shown. The actual curves of both the inbound and outbound tracks would, however, vary somewhat from this configuration.

At the Harvard Square Station, the center lines of the proposed inbound and outbound tracks are separated on the vertical profile and lie within 20 feet of each other horizontally. Proceeding north towards Porter Square, the horizontal distance between track center lines increase to 40 feet and tracks reach the same level below ground, just north of Flagstaff Park. From this point, the tracks descend at close to maximum allowable grade to enter rock as soon as possible. After entering rock the descending grade changes to minimum grade along the section leading to Porter Square Station.

A deep vertical alignment in rock was selected to avoid soft ground and mixed face soil conditions which would make tunnelling procedures difficult. Additional geotechnical investigation is planned to provide a basis for determining a final tunnel profile and avoiding the mixed face condition insofar as possible, while preserving the advantages of the deep alignment, i.e., reduce potential for damage to utilities, diminish impact of construction noise and minimize potential for settlement of nearby buildings.

Two ventilation and emergency shafts would be placed along the alignment between Harvard Square and Porter Square at approximately the following locations:

- Massachusetts Avenue, vicinity of Everett Street
- Massachusetts Avenue, vicinity of Garfield Street

An underground traction station is being considered for the area.

Station

The Porter Square Station would be the deepest station on the proposed Red Line Extension. The depth has been generated from the geotechnical criteria for rock excavation of a vaulted station section and the desire to maintain the tunnel excavation in rock from Porter to Davis Square. The station configuration has a split level center platform, 440' in length and 77' in width, with the outbound track 13'-6" below the inbound track elevation of 40.0', some 100' below the surface. The split level platform section allows a low vaulted side entry from the main escalators to the mezzanine, a section compatible with good rock excavation techniques.

The mezzanine would serve as the junction between the deep station platform and patron access from the MBTA Commuter Rail System and the surface headhouses at Porter Square. The mezzanine is located in plan between the MBTA Commuter

Rail line and Somerville Avenue approximately 40' below grade. This permits simple, direct escalator access to the commuter rail line and the surface. The mezzanine provides for the transition from the freely accessible public access of the station complex to the pay zone.

The mezzanine configuration allows for unpaid pedestrian connection under Massachusetts Avenue, a future headhouse connection under Somerville Avenue, and a new pay connection to the commuter rail. Provisions would be made to allow for a change in the commuter rail connection from the free zone to the paid zone of the mezzanine and thus allow a future free transfer between the Red Line and the commuter rail line. The mezzanine would also house, adjacent to the pay zone, public and employee rest rooms and associated program spaces related to the operation of the station.

Two street level entrances would provide pedestrian and bus transfer access to the station mezzanine from both the east and west sides of Massachusetts Avenue. The station entrances would be located so that the mezzanine could be reached without crossing Massachusetts Avenue with crossing to Somerville Avenue via a new surface pedestrian street crossing. Existing curb-side bus stops could be relocated in close proximity to the street entrances. Both street entrances would house two escalators and a stair.

The street entrance on the east side of Massachusetts Avenue located over the mezzanine would serve as the primary entry. A portion of the MBTA Railroad right-of-way would be decked to provide a public plaza giving access to the commuter rail line from the street and to the primary station entrance from the south. An elevator would provide barrier-free access from the plaza to the commuter rail line, and a second elevator would provide barrier-free access from the primary street entrance to the mezzanine and both levels of the station platform. The street entrance to the west of Massachusetts Avenue serves the local south-bound bus transfer and residents of the Upland Road and North Cambridge communities. The west side street entrance connected by tunnel to the mezzanine would provide for a vehicular-free pedestrian crossing of the avenue.

Access to the main station level from the paid zone of the mezzanine consists of three escalators and stairs. Two of the escalators would provide single directional movement for the 68 vertical foot rise with the third escalator providing movement in the peak direction and also serving as a replacement if one of the single directional escalators is out of service.

The station volume would continue approximately 50' beyond the station portals to accommodate mechanical equipment, the vent shaft to allow the dampering of the trains' "piston action", and emergency egress requirements. The chamber at the south end of the station will house emergency stairs, exhaust and supply mechanical equipment which will come to the surface behind the potential joint development site between the Commonwealth Lock Building and the MBTA Railroad right-of-way. The chamber at the north end of the station would also accommodate the air relief shaft required to reduce the "piston effect". This shaft would terminate in a surface grating in the parking lot of the Porter Square Shopping Center.

The existing commuter rail stop at Porter Square would be upgraded to accommodate the potentially significant transfer connection with the Red Line. As presently conceived, the station would be rebuilt as a center platform station of 550' in length with canopy cover for two train lengths. The rail would be lowered to provide the necessary clearances under the Massachusetts Avenue bridge to accommodate pentagraph equipped cars. A reversible escalator and a stair would provide access to the Red Line Station mezzanine while access to street level would be via a stair and elevator to the decked plaza.

Principal features of the proposed station are illustrated on Figures IV-3 and IV-4.

Right-of-Way

From the end of the proposed Harvard Square Station to the proposed Porter Square Station, the subway segment would be almost entirely within public right-of-way. The properties involved and the proposed project requirements are shown in Table IV-1.

Table IV-1

RIGHT-OF-WAY REQUIREMENTS
HARVARD SQUARE TO PORTER SQUARE

ADDRESS	TYPE	USE
1320-1324 Massachusetts Avenue	Commercial	Construction Easement
1326-1328 Massachusetts Avenue	Commercial	Construction Easement
1358-1362 Massachusetts Avenue	Commercial	Utility & Construction Easements
1350-1354 Massachusetts Avenue	Commercial	Utility & Construction Easements
1336-1346 Massachusetts Avenue	Commercial	Utility & Construction Easements
1372-1376 Massachusetts Avenue	Commercial	Construction Easement
1380-1392 Massachusetts Avenue	Commercial	Construction Easement
Harvard Yard	Institutional	Permanent, Utility & Construction Easements
Old Burying Ground	Historic	Construction Easement
1448-1454 Massachusetts Avenue	Commercial	Construction Easement
1416-1442 Massachusetts Avenue	Commercial	Construction Easement
1511 Massachusetts Avenue	Institutional	Partial Taking/ Construction Easement
Gannett House (Massachusetts Avenue)	Institutional	Partial Taking/ Construction Easement
Flagstaff Park	Public Park	Permanent & Construction Easements
Cambridge Common	Public Park	Permanent Easement
North Little Common	Public Park	Permanent Easement
1599 Massachusetts Avenue (Garage)	Institutional	Construction Easement
6-8 Everett Street (Garage)	Institutional	Construction Easement

Table IV-1 (continued)

ADDRESS	TYPE	USE
1601 Massachusetts Avenue (Garage)	Institutional	Partial Taking/ Construction Easement
1603 Massachusetts Avenue (Garage)	Institutional	Partial Taking/ Construction Easement
1699 Massachusetts Avenue (Midget Parking Lot)	Commercial	Partial Taking/Permanent & Construction Easements
1815-1843 Massachusetts Avenue (Sears)	Commercial	Partial Taking/Permanent, Construction & Utility Easements
1847-1853 Massachusetts Avenue (Commonwealth Lock)	Commercial	Permanent & Construction Easements
1855-1867 Massachusetts Avenue (Flag Store Group)	Commercial	Total taking of land and structures for station structures
835 Somerville Avenue (Professional Building)	Commercial	Total taking of land and structures for station structures
821-830 Somerville Avenue (Dodge Dealer)	Commercial	Permanent, Utility & Construction Easements
1-55 White Street (Porter Square Shopping Center)	Commercial	Partial Taking/Permanent, Utility & Construction Easements
1890-1906 Massachusetts Avenue (Corey Realty)	Commercial	Total Taking

Construction Considerations

Beginning at the northern end of the Harvard Square Station structure and continuing northerly under Massachusetts Avenue, shield driven, tunnel/deep bore method is anticipated to the interface of full face soft ground with rock, at a point south of Garfield Street. Based on present knowledge of the geology along the alignment, compressed air is not likely to be required.

Continuing to the North towards Porter Square from the rock/soft ground interface, there would be short segments of hand-mined tunnels to a point where the tunnels are under 10' of sound rock cover. From this point, the tunnels will be bored by Tunnel Boring Machine (TBM) or conventional methods through the Garfield Street Vent Shaft to a construction shaft just south of the Porter Square Station.

The location of a construction shaft just south of Porter Square Station is particularly desirable because of its proximity to the MBTA right-of-way. Railroad land could be made available for construction of an access road. Also, the railroad right-of-way could facilitate the supply of construction materials and disposal of excavated materials.

The Porter Square mezzanine and circulation to the station would be constructed by the cut-and-cover method except for a pedestrian tunnel under Massachusetts Avenue. This would be constructed by a combination of cut-and-cover and deep bore techniques. The main station platform volume would be constructed in rock by mining techniques with the relief shafts constructed using open surface excavation.

In addition to the actual station construction, some construction would be required to maintain existing services and structures. The Harvard Trust/Commonwealth Lock Building may require underpinning during the tunnel/deep bore operations.

Maintenance of vehicular traffic on Somerville Avenue, parking at Porter Square Shopping Center, and railroad operations along the

Fitchburg Division will be major factors during the construction period. Open construction work on Massachusetts Avenue should be minimal as the major station area would be east of the avenue. Traffic on Somerville Avenue could be maintained by temporary decking. It would also be necessary to provide support for the railroad tracks to allow uninterrupted rail operations.

The major utility requiring relocation or support within the excavation site is a 48-inch Metropolitan District Commission (MDC) water line along Somerville Avenue. Other utility lines in the immediate vicinity include a 16-inch MDC water line, a 12-inch gas line, one 17-inch by 21-inch sewer, an eight-inch sewer, a six-inch water main, and Cambridge Electric duct banks. Treatment of these utilities will require further study during the design phase of the project.

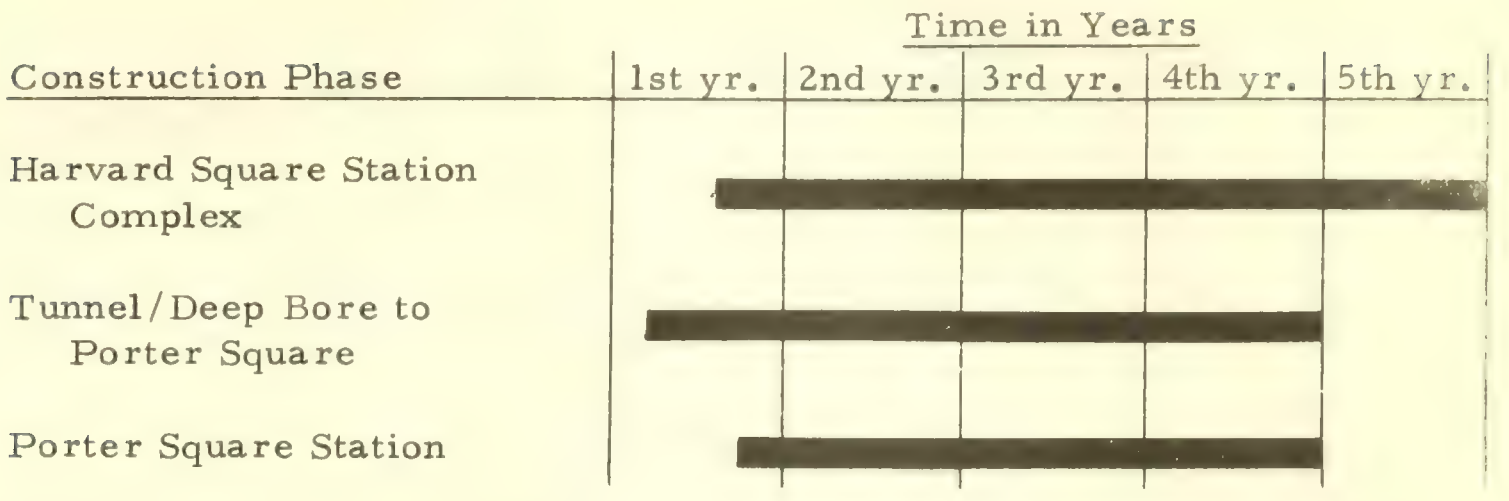
Along Massachusetts Avenue there are a number of utilities that would have to be considered. Of special concern are the effects of ground settlement on the 48-inch MDC water line, gas lines, and sewers.

Throughout the alignment, the groundwater table would be within the construction limits. Groundwater, in most areas, can be controlled by dewatering, but some recharging operations may be necessary. There is no indication that a compressible stratum exists below the bottom of the tunnel, nor does the void ratio of the granular material indicate that dewatering would cause a settlement problem. Other methods such as the grouting of appropriate soils and the construction of cutoff walls will be considered during the design stages.

The construction sequence that follows is based on the desirability of having various phases completed at appropriate times. For example, the tunnel/cut-and-cover work should be sufficiently completed to the interfaces of tunnel/deep bore segments to allow tunneling machines to be maneuvered.

Table IV-2

ESTIMATED CONSTRUCTION TIME



Costs

An itemized breakdown of estimated subway construction costs between Harvard Square and the Porter Square Station is presented below. For this segment, the estimate begins at the interface of tunnel/cut-and-cover and tunnel/deep bore construction near Harvard University's Hemenway Gym on Massachusetts Avenue and terminates at the North end of the Porter Square Station. The costs do not include project wide items such as floating slabs, trackwork, ventilation, electrification, signalization and communications. For these costs see Chapter II. The estimate is based on midpoint of construction costs.

Table IV-3

ESTIMATED CONSTRUCTION COSTS
HARVARD SQUARE TO PORTER SQUARE
(Does not include Project wide items)

Item		Cost	
Tunnel/Deep Bore to Porter Square			
MAC Code	Description	Amount	
15.13.20	Tunnel Structure	$59,242,000	
15.13.10.12	Utility Relocation	876,000	
15.10.00	Demolition	15,000	
15.13.00	Protection & Repair of Existing Structures	2,100,000	
			$62,233,000
15.06.10	Right-ofWay	1,890,000	
			1,890,000

Table IV-3 (continued)

15.08.01	Professional Services	3,111,000		
15.15.02	Field Inspection	1,920,500		
15.15.02	Force Account	622,500		
15.16.00	Project Administration	3,885,000		
			9,539,000	
	Subtotal			$73,662,000
32.00.00	Contingencies			6,224,000
	Total			$79,886,000

Porter Square Station

MAC Code	Description	Amount		
15.11.10	Station Structure	$33,935,000		
15.13.10.12	Utility Relocation	500,000		
15.13.10.11	Remove & Relocate RR Tracks	550,000		
15.13.00	Protection & Repair of Existing Structures	300,000		
15.10.00	Demolition	150,000		
			$35,435,000	
15.06.10	Right-of-Way	200,000		
31.00.00	Relocation	100,000		
			300,000	
15.08.01	Professional Services	2,480,000		
15.15.02	Field Inspection	1,096,000		
15.15.02	Force Account	689,000		
15.16.00	Project Administration	2,217,000		
			6,482,000	
	Subtotal			$ 42,217,000
32.00.00	Contingencies			3,544,000
	Total			$45,761,000
		Segment Total		$125,647,000

ALTERNATIVES

Line Segment Alternatives

The BTPR Red Book presented two construction alternatives--tunnel/cut-and-cover and tunnel/deep bore--for the proposed BTPR Alignment 3 along Massachusetts Avenue from Waterhouse Street to Porter Square. The tunnel/deep bore method was selected for this segment of the project. The various alternatives studied for the proposed Harvard Square Station area between Waterhouse Street and the existing Red Line have been discussed in Chapter III.

The cut-and-cover option along Massachusetts Avenue was developed in 1968. Although this option would save an estimated $10 million in construction costs, it met with significant community opposition. The disruption of Massachusetts Avenue traffic and interference with activities in adjacent business and residential areas were the principal concerns. Based on this opposition, the cut-and-cover alternative was eliminated. A Cambridge City Council, Harvard-Alewife resolution dated October 26, 1970 states in part:

"...AND BE IT FURTHER RESOLVED that this City Council hereby affirms a strong commitment to support the Massachusetts Bay Transportation Authority on a continuing basis in a joint effort to plan and construct a deep-bore Harvard-Alewife extension at the earliest possible date."

This feeling was reaffirmed by Council resolutions adopted April 30, 1973 and June 23, 1975, supporting as its official policy the extension of the Red Line from Harvard Square to Route 128 via Porter Square in Cambridge and Davis Square in Somerville. (See Appendix F for copies of these resolutions.)

Station Alternatives

The BTPR Study developed three alternative locations for the proposed Porter Square Station. These alternatives, designated as A, B and C, are illustrated in Figure I-3. After a review and analysis, a 1973 Cambridge City Council resolution recommended the selection of the B location, assuming the construction of a Davis Square Station.

Starting with this location, the Porter Square Transportation Advisory Group (TAG) discussed its merits and liabilities as they related to the needs and desires of the residential and business communities. It became apparent that this location would not entirely satisfy the community's desires as voiced by the TAG and particular concern was expressed relative to pedestrian connections to all sections of Porter Square.

As a result of these TAG discussions, three alternatives of the original location were developed, B.1, B.2 and B.4, with B.3 representing the original B location from the BTPR report. Figure IV-5 diagrams each of the alternatives considered. Discussions at TAG meetings and with neighborhood groups as well as business and city representatives resulted in a consensus that the B.4 alternative would be the most advantageous site for the Porter Square Station. This location would require the displacement of six businesses between the Harvard Trust/Commonwealth Lock Building and Somerville Avenue, as illustrated in Figure IV-2. Potential redevelopment opportunities available for the single displaced property owner will be reviewed and summarized in the Joint Development portion of the Land Use section of this chapter.

Although alternative B.4 met all TAG desires for a central location with easy pedestrian access throughout the Square and to the commuter rail station, four principal concerns remained:

1. Potential disruption of Harvard Trust and Commonwealth Lock daily business operations because of the difficulty involved in maintaining access during construction activities.

2. Potential disruption of traffic on Massachusetts Avenue, due to the major construction required for the south portion of the station.

3. Cost of underpinning the Harvard Trust/ Commonwealth Lock Building (approximately $100,000).

4. Difficulty in locating the elevator so that it would be convenient for handicapped riders on both the commuter rail and Red Line Extension.

Further study resulted in modifications that significantly reduced or eliminated these four factors. The B.4 (revised) station location has been previously described as the project station. The B.4 (revised) alternative relieved the four principal concerns by:

1. Shifting the station location approximately 175 feet further north. This would place major construction activities north of the Harvard Trust/Commonwealth Lock Building and reduce potential disruption to business and residential activities.

2. Placing major construction activities completely away from Massachusetts Avenue to eliminate the need to detour traffic. The possibility of blocking the Massachusetts Avenue entry to the Sears Roebuck and Co. parking lot would also be avoided.

3. Reducing the costs involved in underpinning the Harvard Trust/Commonwealth Lock Building or possibly, eliminating the need for this protection.

4. Providing a convenient location for the elevator adjacent to the east station entry.

The Cambridge City Council affirmed its support of the Revised B.4 station location by passing a Resolution on June 23, 1975 which, in part, read:

"...AND BE IT FURTHER RESOLVED that the location and design characteristics of the Porter Square Station should conform, in principle, to the alternative known as B-4, Second Revision, though not necessarily in specific location-details as shown on the plan; and that B-4, Second Revision, which is the consensus choice of the Porter Square Transportation Advisory Group, shall be understood to incorporate the following major features:

- A location which runs northeast, starting just north of the Harvard Trust Company building, beneath the MBTA Railroad right-of-way and Somerville Avenue to a point under the Porter Square Shopping Center parking lot, thereby minimizing disruption to Massachusetts Avenue;

- Free use of patron access tunnels for pedestrian circulation in and around Porter Square;

- Convenient access from both Porter Square and the transit station to the MBTA Railroad Station:

- Specific exclusion of transit-related automobile parking and off-street bus facilities from the station design; and

- Access to the south and north ends of the station from the vicinity of both sides of Massachusetts Avenue..."

TRAFFIC AND TRANSPORTATION

Existing Conditions

The proposed Porter Square Station would be served by Massachusetts Avenue from the north and south, by Somerville Avenue, which terminates at Porter Square, from the east, and by Upland Road from the southwest. The estimated 1975

1. Potential disruption of Harvard Trust and Commonwealth Lock daily business operations because of the difficulty involved in maintaining access during construction activities.

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- Free use of patron access tunnels for pedestrian circulation in and around Porter Square;

- Convenient access from both Porter Square and the transit station to the MBTA Railroad Station:

- Specific exclusion of transit-related automobile parking and off-street bus facilities from the station design; and

- Access to the south and north ends of the station from the vicinity of both sides of Massachusetts Avenue..."

TRAFFIC AND TRANSPORTATION

Existing Conditions

The proposed Porter Square Station would be served by Massachusetts Avenue from the north and south, by Somerville Avenue, which terminates at Porter Square, from the east, and by Upland Road from the southwest. The estimated 1975

Average Daily Traffic (ADT) and forecasted 1980, 1985 and 2000 ADT are shown in Table IV-4.

Table IV-4*

AVERAGE DAILY TRAFFIC
(vehicles per day)

Route	1975	1980	1985	2000
Massachusetts Avenue (North of the Square)	39,300	39,800	40,300	41,800
Massachusetts Avenue (South of the Square)	20,200	20,400	20,700	21,500
Somerville Avenue	13,100	13,300	13,400	13,900
Upland Road	6,000	6,100	6,200	6,400

* Source: CTPS

Congestion often occurs at Porter Square as a result of traffic generated by the area's retail activities and the large traffic volumes on Massachusetts and Somerville Avenues. The termination of Somerville Avenue further contributes to the congestion. Direct vehicular access from the Porter Square Shopping Center to the intersection of Massachusetts and Somerville Avenues creates turning conflicts and obstructs through movements. Traffic control is accomplished by channelization and traffic signals at Somerville Avenue and at Upland Road. Although improvements are presently being considered, the Massachusetts Avenue bridge over the MBTA railroad tracks is a further operational constraint. Surrounding streets are residential in nature with low vehicular capacities.

In a letter dated June 27, 1977, James L. Sullivan, City Manager of Somerville, raised the question of the potential desirability of replacing the Massachusetts Avenue bridge at the same time as the proposed Porter Square Station is constructed. The MBTA is currently entering discussions with the MDPW to discuss the need and schedule of reconstructing the bridge.

Station Boardings

It is estimated that a Red Line Extension to Route 128, Arlington Heights, or Alewife would generate approximately 6,200 inbound boardings per day at the Porter Square Station. Table IV-5 shows estimated 1980 daily inbound boardings at the Porter Square Station by mode of access for each alternative terminus.

Table IV-5

ESTIMATED 1980 DAILY INBOUND BOARDINGS *
PORTER SQUARE STATION

	Mode of Access					
Alternative Terminus	Walk-In	Bus	Kiss-and-Ride	Commuter Rail	Park-and-Ride	Total
Route 128	1,660	2,780	1,190	560	-	6,190
Arlington Heights	1,660	2,780	1,190	560	-	6,190
Alewife	1.660	2,780	1,190	560	-	6,190

* Source: CTPS

Based on CTPS ridership demand estimates, the location of the Red Line Extension terminus is not expected to substantially influence ridership at the Porter Square Station since the potential patronage at this station would be largely local in nature. Table IV-6 shows the expected additional peak-hour auto arrivals at Porter Square Station by access route for each alternative terminus.

Table IV-7 gives the estimated feeder bus requirements and supply strategies to satisfy the expected peak-hour transit rider demand at the Porter Square Station.

Table IV-6

ESTIMATED 1980 PEAK HOUR VEHICLE ARRIVALS VIA AUTO*
PORTER SQUARE STATION

Access Route (D)[a] and Alternative Terminus	Mode of Access: Park-and-Ride	Mode of Access: Kiss-and-Ride	Total
Massachusetts Avenue (N)			
. Route 128	-	30	30
. Arlington Heights	-	30	30
. Alewife	-	30	30
Massachusetts Avenue (S)			
. Route 128	-	80	80
. Arlington Heights	-	80	80
. Alewife	-	80	80
Upland Road (SW)			
. Route 128	-	80	80
. Arlington Heights	-	80	80
. Alewife	-	80	80
Somerville Avenue (E)			
. Route 128	-	75	75
. Arlington Heights	-	75	75
. Alewife	-	75	75

(a)
(D) - Denotes direction from which arrival originates (i.e., (N) = from the North).

* Source: CTPS

Table IV-7

ESTIMATED 1980 PEAK-HOUR FEEDER BUS REQUIREMENTS AND SUPPLY STRATEGIES PORTER SQUARE STATION*

Approach Direction	Requirements For Alternative Terminus			Supply Strategy		
		Arlington		1975	1980	
	Route 128	Heights	Alewife	Existing	Minimum	Maximum
North and West	21	21	21	57	16	17
South and East	5	5	5	66	16	17
Total	26	26	26	123	32	34

* Source: CTPS

As shown in Table IV-7, the number of existing peak-hour bus arrivals at Porter Square far exceeds the estimated number of feeder buses required to serve transit riders; this is largely because of the many Harvard-bound express buses which converge on Massachusetts Avenue. Under both the minimum and maximum bus supply strategies, which would modify existing bus service in response to the Red Line Extension, additional feeder bus service would be required from the north and west. By curtailing express bus service on Massachusetts Avenue and reorienting the routes to provide localized feeder service, bus traffic in the station area should be significantly reduced after Red Line Extension becomes operational.

Porter Square is intended to be a local Red Line Extension stop offering direct service between Cambridge and downtown Boston. Patronage is expected to be primarily local, with the station attracting only a limited number of residents from outlying communities; therefore, park-and-ride facilities would not be provided. Feeder bus and kiss-and-ride activities would occur at street level and no special provisions would be required for these operations. To accommodate the anticipated number of walk-in patrons, an entrance from the street to the station would be located on both the east and west sides of Massachusetts Avenue. These entrances would

provide pedestrians with access to the station area without requiring them to cross Massachusetts Avenue.

Impacts

The CTPS estimated that the demand for parking by Red Line Extension riders would be approximately 290 vehicles per day regardless of which terminus is selected. The lack of long-term parking facilities at the Porter Square Station would divert a portion of this demand to either kiss-and-ride or feeder bus. Nevertheless, park-and-ride demand would exceed the supply and it is conceivable that a large portion of this excess demand would elect to park-and-ride in spite of the limited parking available. The use of on-street parking spaces in the vicinity of the station by transit riders would be discouraged by the City's Resident Parking Sticker Program. However, unless this program is strictly enforced, the amount of parking available for community residents would be reduced. The use of on-street parking spaces by transit riders combined with the use of nearby commercial parking lots, would contribute to local traffic congestion and reduce the short-term parking supply. A portion of this excess park-and-ride demand would choose not to use the Red Line and would travel by automobile, thus limiting the potential ridership on the Extension.

The large number of expected kiss-and-ride passengers would constrict traffic flow during peak periods. Specifically, the lack of off-street loading and unloading areas at the station would encourage double parking and create through traffic delays, which would be particularly evident during the evening peak-hour as kiss-and-ride vehicles queue along the approach streets.

The amount of on-street space required for the estimated 26 peak-hour bus arrivals could also constrict traffic flow in the Square; however, since more than 120 buses currently arrive at Porter Square during the peak-hour it is expected that the substantial reduction in total volume would offset the effects of longer dwell times at the transit station.

A Red Line Station at Porter Square would result in a slight decrease in daily and peak-hour traffic volumes due to auto diversions; however, this would be offset by an increase in vehicular traffic induced by the station, primarily kiss-and-ride vehicles.

Table IV-8 shows the estimated daily and peak-hour net changes in traffic volumes at the Porter Square Station.

Table IV-8

NET CHANGE IN TRAFFIC VOLUMES AT PORTER SQUARE
(Vehicles)

Alternative Terminus	Daily	Peak-Hour
Route 128	-	-
Arlington Heights	+300	+ 50
Alewife	+900	+100

During construction of the station, traffic would be slowed on most major arterials leading into the Square. There would be little or no interruption of traffic on Massachusetts Avenue; however, traffic on Somerville Avenue would be slowed for approximately ten to 14 days while the temporary deck is placed. No detouring of traffic from major roadways is anticipated.

Mitigating Measures

Local enforcement of parking regulations would be required to restrict the use of on-street parking spaces by transit riders. Off-street commercial parking areas, such as the Porter Square Shopping Center and Sears Roebuck and Co. parking lots, may attract a small number of transit users if they are not controlled. Unauthorized parking by transit users could be controlled by:

1. Installation of short-term parking meters in conjunction with a towaway service contract. This service could be provided at a minimal cost to the businesses and would be most effective in controlling unauthorized parking.

2. Installation of manual or automatic entries and exits using authorized tokens or stamps.

3. Posting of parking restrictions and enforcement of limits.

The potential congestion that could result from kiss-and-ride activities could be minimized by designating certain curb areas along Massachusetts and Somerville Avenues for kiss-and-ride use. The discharge and pickup of kiss-and-ride passengers during the peak-hours would be facilitated and double parking, with the consequent long delays along major roadways, would be avoided.

The Red Line Extension would eliminate the need for Massachusetts Avenue express bus service. The subsequent removal of a large number of through buses in Porter Square would increase vehicular capacity and travel speeds.

LAND USE

The entire length of the Harvard Square-Porter Square section is physically within the boundaries of the City of Cambridge, but its land use influence, particularly in Porter Square, extends into Somerville. General remarks pertaining to Porter Square would, therefore, apply to both jurisdictions. With the exception of minimal cut-and-cover operations at Porter Square and surface construction activities associated with the two ventilation/emergency shafts, a majority of the construction activities would be below the surface.

Existing Conditions

Plans

The City of Cambridge has no physical development plan for the area surrounding the Harvard Square-Porter Square section of the proposed Red Line Extension, but a comprehensive Policy Plan is currently being prepared. As part of the Open Space Land Program for the beautification of Porter Square, the Cambridge Department of Public Works has proposed a series of improvements which include the addition of lane dividers and new pavement treatment as well as landscaping and the provision of benches.

Recently, a draft of a Harvard Square Comprehensive Policy Plan was produced to serve as a guide for the physical development of the Harvard Square area. If adopted and implemented, it could generate a development spillover effect toward Porter Square as new commercial activities are unable to locate in Harvard Square.

Policies

The City Council of Cambridge has taken an official position on the Red Line Extension through the adoption of resolutions dated April 30, 1973 and June 23, 1975. Excerpts from the April 30, 1973 resolution most relevant to this particular section of the proposed extension are presented below.

- "Cambridge recommends that the Line Extension follow BTPR Alignment Alternative #3 (Via Davis Square, With a Station South of Porter Square) From Harvard Square to Alewife Brook, . . ."

- "In recommending Alignment #3 Via Davis Square, Cambridge Underscores its Intent that Should the Davis Square Route Prove Unacceptable to the Somerville City Government, the State, or the Federal Government, the Alternate to Be Substituted Will Be Alignment #1, The Garden Street Route."

The City of Cambridge supports a Porter Square station only if:

- "The station is constructed and operated without commuter automobile parking or off-street bus facilities;

- "A means is found for ensuring that people using the transit system do not park in the Sears or Porter Square Shopping Center lots, or on residential streets in the Porter Square area;

- "Traffic circulation on Massachusetts Avenus is not disrupted during the construction of the station;

- "Means are found to ensure that the pedestrian movements associated with the transit station do not conflict with the traffic circulation (such means to include, as a minimum, the construction of convenient, well-lighted pedestrian access ways to either platform (northbound and southbound) from both sides of Massachusetts Avenue);

- "There is an understanding that should detailed studies show that the above conditions cannot be met, the extension will be built to proceed directly from Harvard Square to Davis Square, without an intermediate station."

The Council recommended the selection of the Sears Roebuck and Co. station location (Alternative B in the BTPR Report) to serve the Porter Square area. This original B alternative has been described in the Station Alternatives section of this chapter. Excerpts from the June 23, 1975 resolution most relevant to this particular section of the proposed extension, in addition to those cited on page IV-10, are:

"...WHEREAS, on April 30, 1973, the Cambridge City Council unanimously adopted a resolution supporting as its official policy the extension of the Red Line from Harvard Square to Route 128 via Porter Square in Cambridge and Davis Square in Somerville; and

WHEREAS, the MBTA and its consultants have shown that stringent parking and traffic circulation conditions imposed on the Porter Square Station by the above-cited resolution have been or can be essentially satisfied by their current proposal; and

WHEREAS, the Porter Square Transportation Advisory Group, composed of people from the surrounding neighborhoods and the business community, has reached a consensus on station location and general design features for the Porter Square Station;

NOW THEREFORE BE IT RESOLVED that the Cambridge City Council hereby reaffirms its desire to have a rapid transit station located in Porter Square;

AND BE IT FURTHER RESOLVED that the City Council's reaffirmation of a station located at Porter Square is contingent upon finding a means for ensuring that the people using the transit system do not park in the Sears or Porter Square Shopping Center parking lots, as well as upon a finding that the Red Line Extension will be carried to Route 128, and that construction of the segment running northwest from Alewife Brook will begin no later than construction between Davis Square and Alewife Brook;

AND BE IT FURTHER RESOLVED that the Porter Square Station be designed so as to improve and optimize its impact on the visual and other amenities of Porter Square..."

Zoning

Areas above or immediately adjacent to this section of the project are subject entirely to the Cambridge Zoning Ordinance; however, because of Porter Square's proximity to the city boundary, the Somerville zoning applicable for that area should be considered in assessing the potential for future development. Existing zoning in the proposed station area (illustrated in Figure IV-1) would permit development of a continuous commercial strip starting on Massachusetts Avenue just north of Wendell Street and continuing north to Russell Street. The B-A Zone south of Arlington Street permits real estate developments for business activities up to a maximum height of 35 feet and for residential uses, up to 85 feet. The recently created B-C Zone with an FAR of 2.0 and a 55 foot height limit abuts residential zones on all sides.

Current Land Uses

The proposed route of the tunnel would be under Massachusetts Avenue to a point in Porter Square near the Sears Roebuck and Co. department store where it would pass under several private commercial properties: the Sears Roebuck and Co. building, the Harvard Trust/Commonwealth Lock Building and the Professional Building (the old Boston and Maine Railroad Station). The only residential activities along this line segment are several apartments on the upper floors of the Harvard Trust/Commonwealth Lock Building. Land use abutting the tunnel alignment and station area is predominantly commercial mixed with medium and high density residential.

A local commercial area providing retail goods and services surrounds the proposed site of the Porter Square Station with two centers of commercial activity grouped around the Sears Roebuck and Co. store to the south and the Porter Square Shopping Center

and an automobile dealer to the north. Surrounding the commercial areas, there are several established residential neighborhoods: the Spring Hill and Ward Two areas of Somerville; the Orchard Street and Walden Street areas of North Cambridge; the Upland Road portion of Neighborhood Nine, and the Oxford Street portion of the Agassiz Neighborhood.

The commercial area is physically divided into four quadrants as a result of the cross formed by the depressed Fitchburg Main Line and Massachusetts Avenue. Such strong physical barriers make circulation--particularly pedestrian activity--between neighborhoods and business areas difficult and dangerous. These physical barriers have also made it difficult to develop a centralized Porter Square commercial area such as Harvard Square or Central Square.

Development Trends

Current residential development in Cambridge's C-3 residential zone indicates a trend toward high-rise, high density construction. Pressure for such construction has been particularly noticeable in the areas near Harvard University and Lesley College.

Along the proposed route of the Red Line Extension, Porter Square is second only to Harvard Square as a viable commercial area according to the Cambridge Office of Economic Development and Manpower. Between 1967 and 1972, Porter Square was Cambridge's fastest growing retail area. In 1972, Porter Square's commercial area (approximately 24 stores) experienced a $35,311,000 increase in sales volume which, when considered with the total payroll, made it one of Cambridge's major retail centers. At present, this growth in sales has not significantly altered the size and type of business establishments in the Square, but it has increased parking demand.

Impacts

Property Takings

Station construction would displace two business property owners and require the relocation of six businesses, thus

creating a direct impact on present land uses. The six businesses are:

- H & R Block, 1865 Massachusetts Avenue
- Of Cabbages & Kings, 1859 Massachusetts Avenue
- Carmin's Modern Barber Shop, 1861 Massachusetts Avenue
- Mini Carpet Shop , 1863 Massachusetts Avenue
- Flag Center, 1865 Massachusetts Avenue
- Professional Building, Somerville Avenue

Small portions of other properties where no structures are involved would be taken for proposed station entrances.

Station Construction

No significant disruption or slowing of Massachusetts Avenue traffic is expected as a result of station construction activities. Construction of the entrance tunnel under Massachusetts Avenue by a combination of cut-and-cover and tunnel/deep bore techniques would significantly reduce the amount of affected roadway surface. Other traffic, transportation and construction considerations have been discussed earlier in this chapter.

A temporary narrowing of Somerville Avenue near the shopping center could cause some limited congestion. During this time a deck (temporary road surface) would be placed to carry Somerville Avenue traffic while construction continued. Truck traffic associated with station construction could possibly use a temporary road constructed in the MBTA Fitchburg Main Line right-of-way for hauling materials and waste to and from the construction area.

Commercial Activities

Both residential and business activities in Porter Square, North Cambridge and South Somerville would benefit from proximity to a rapid transit station. The estimated 6,190 daily boarders would have easy access to both major Porter Square shopping areas, and the proposed intermodal transfer between the Red Line station and the MBTA commuter rail service would further increase the commercial attractiveness of the proposed station. Construction activities in the station area should not significantly interrupt business activities or restrict customer access.

Other short-term impacts related to construction would be the temporary displacement of parking spaces in the Porter Square Shopping Center. Commuter rail service would not be disrupted as continuous service on the MBTA Fitchburg Main Line would be maintained.

Induced Development

High density development trends in the nearby residential and business zones of Cambridge and Somerville indicate that the increased accessibility of the Red Line Extension could accelerate land development and speculation in the Porter Square area. Likely areas for such development would be the C-2, C-3, B-A, and B-C zones in Cambridge and the RC, B-A and B-B zones in Somerville. However, depending on the site and type of adjoining structures, high-rise structures could be inconsistent with existing low density residential areas.

A potential joint development location for commuter-oriented retail establishments could be created around the station's east entrance as suggested in Figure IV-3. Based on the past growth of Porter Square sales, the long-term potential for increased commercial development seems promising. The Red Line Extension would reinforce existing businesses and create some new commercial opportunities. However, if the actual number of boarders stabilizes at a level similar to that projected, the amount of new commercial activity would be moderate.

Joint Development

Two opportunities for potential joint development exist in the area of the Porter Square Station. There is a potential for redevelopment of commercial spaces around the station area, as mentioned above. If future demand makes it economically feasible, there is a possibility of using the MBTA railroad air rights for either public or commercial uses.

Redevelopment above the station could be accomplished in several ways. The displaced property owner, by use of a permanent easement, could retain ownership of those portions of land not actually needed for station street level activities, or the property could be purchased by the MBTA and could be leased back to the former or a new owner after construction. In both cases, excluding MBTA improvements on the properties would be taxable.

Development of the MBTA Commuter Rail air rights, although at present too costly to be justified for parking or commercial use, could provide significant benefits for Porter Square in the future. Developing these air rights would also tend to eliminate the present barrier-like effect of the railroad. Possible uses for this development could include open space, parking, small shops and businesses, and pedestrian walkways.

Urban Design

The completed Porter Square Station, as proposed, would not significantly alter the physical appearance of Porter Square at street level. A significant improvement would be made in the esthetic appearance of the MBTA commuter rail station by the construction of new platforms and canopies.

The two entrance structures and the removal of the buildings between the Harvard Trust/Commonwealth Lock Building and Somerville Avenue would be the most noticeable street level changes. Note that the possible joint development of commercial activities is merely a suggestion and would not be included as a part of the proposed construction activities.

Mitigating Measures

Property Takings

MBTA procedures are in compliance with the Federal Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 and Chapter 79A of the General Laws of Massachusetts.

The MBTA Right-of-Way and Relocation Department would compensate owners for acquired property by:

- Retaining two independent assessors to appraise the fair market value of each property or structure.
- Providing compensation for long-term lease terminations.

Owners would still have the right to appeal the established level of compensation and acceptance of this compensation would not prejudice the owners right to litigate for an adjustment.

In all business relocations, MBTA Right-of Way and Relocation Department staff would:

- Give a minimum of four months notice to vacate.
- Provide advisory services to the project area if economic injury is involved.
- Provide relocation payments, including:

  Actual moving expenses

  Payment for direct loss of property

  Payment in lieu of relocation and related expenses

  Expenses in searching for a new location

  Storage costs

  Property loss compensation

Redevelopment Opportunities

Joint commercial development could potentially be negotiated between the displaced property owner or other businessmen and the MBTA to provide for redevelopment of the land adjacent to the south-east station entrance. This could be accomplished by either of two methods: the present owner could retain ownership of the land and sell a subterranean easement, or the land could be sold to the MBTA and leased back to the former owner or other interested businessmen.

Subterranean Easements

Those properties under which the tunnel and station would be located would require a subterranean easement for which suitable compensation would be provided through negotiations between the owner and the MBTA. Compensation procedures would be similar to those outlined in the initial paragraphs of this section.

Station Construction

The principal adverse impact identified with station construction would be the temporary narrowing of Somerville Avenue during decking operations and the partial decking of Massachusetts Avenue for construction of the pedestrian passageway.

Possible mitigating measures include:

- Decking of Somerville and Massachusetts Avenues on weekends and after the evening peak hour to avoid disrupting traffic flow.

- Partial tunneling of the passageway to the west side of Massachusetts Avenue to further reduce traffic or utilities disruption.

- Provision of decking within the Porter Square Shopping Center area to enable re-utilization of parking space as soon as possible.

Induced Development

Recently, a Land Use Subcommittee of the Porter Square Tag examined the rezoning options available in Cambridge to control the scale and compatibility of future developments with existing residential areas. Porter Square's traditional role as a local business area and the desirability of continuing this type of activity was being discussed. The outcome of this study has been a successful rezoning petition to the Cambridge City Council. Porter Square, from Roseland Street to Russell Street was rezoned to a new district designation (B-C). This district has the same use regulations as the former B-B (General Business District). However, it has a lower density (FAR 2.0 instead of 4.0), a 55 foot height limit, and an off street parking requirement. Furthermore, buildings within 50 feet of a residential district must not exceed 35 feet in height. Thus, the Subcommittee work resulted in a strategy utilizing a number of techniques; rezoning, new regulations, and the tightening of existing regulations.

NEIGHBORHOOD AND COMMUNITY FACTORS

Consideration of the short- and long-term effects on the quality of life in adjacent neighborhoods has been a paramount factor in evaluating the proposed Red Line Extension. The Porter Square Transportation Advisory Group (TAG), representing neighborhood and business groups, provided the local input during the planning and assessment process for the section of the Red Line Extension which would include the proposed Porter Square Station. Following is a brief description of the three major neighborhood areas and the additional community considerations examined during the assessment process.

Existing Conditions

The Harvard Square-Porter Square section would pass through three major Cambridge areas--the Agassiz Neighborhood, Neighborhood Nine and the North Cambridge Neighborhood-- and through the Spring Hill and Ward Two Neighborhood areas in Somerville.

Neighborhoods

The Agassiz Neighborhood (also known as Neighborhood Eight) is bounded by Massachusetts Avenue on the west, Kirkland Street on the east and the Somerville-Cambridge boundary on the north. In addition to Harvard University, two distinct sub-neighborhoods, Shady Hill and the Oxford Street area, are located within the Agassiz area. The Oxford Street area, which is nearest to the proposed station, is composed of a few apartment buildings and one-, two- and three-family houses on small lots. Land use is dominated by Harvard University and Lesley College, with approximately half the land being used for institutional purposes. There is no industrial land use in these sub-neighborhoods and commercial activity is generally limited to an area along Massachusetts Avenue. Public open space is negligible.

Neighborhood Nine is bounded by Massachusetts Avenue, the Boston and Maine Fitchburg Main Line right-of-way, Concord Avenue, and Cambridge Common. Originally a part of the 1631 Cambridge community, this area--which has the highest amount of land devoted to residential use of any Cambridge neighborhood--has evolved into an interesting mixture of residential dwellings. Large multi-family buildings are intermixed with one-, two- and three-family houses. Several high density projects, such as the Harvard Student Housing on Linnaean Street, Bristol Arms, Lincoln Way, and Walden Square have been constructed. Massachusetts Avenue, Concord Avenue and areas north of the Common are characterized by large multi-family masonry apartment buildings, many over six stories high with some street level commercial activities.

Neighborhood Nine is fringed on the north by a thin industrial zone running along MBTA railroad right-of-way. This zone is anchored on the southwest by 52 vacant acres (a dump site) and the open spaces in St. Peter's Field. Industrial activities include a variety of research laboratories, scrap metal yards and warehousing. The Common provides open space in the southeast corner of this neighborhood.

The area known as North Cambridge, or Neighborhood 11, is bounded by Somerville on the north, Porter Square on the east, Arlington and Belmont on the west, and by the

MBTA Commuter Railroad on the south. North Cambridge would border on three sections of the Red Line Extension: the Harvard Square-Porter Square, Porter Square-Davis Square, and Davis Square-Alewife. The areas of this neighborhood immediately west of Massachusetts Avenue are closest to the Harvard Square-Porter Square section. North Cambridge is a mixture of residential, commercial and industrial uses, with most of the industrial area concentrated in the western section. Massachusetts Avenue provides a strip of commercial developments varying in intensity from one end of the neighborhood to the other. Two districts of unlimited height business development exist between Porter Square and Russell Street and also in the area of the MBTA storage yards. At present, the uses in these areas do not approach the allowable B-B zone development. Residential activities in North Cambridge are located in the Walden Street and Orchard Street sub-neighborhood areas. In the Walden Street area, two- and three-story multiple family residences, mixed with commercial and industrial activities are found east of Walden Street and south of Massachusetts Avenue. An area of single and multiple family residences is located in close proximity to the Cambridge City boundary and the Spring Hill-Ward Two areas in Somerville.

The Spring Hill-Ward Two areas of Somerville start at the city boundary and extend east to Cutter Street, generally north to Highland Avenue, and east toward School and Medford Streets. The physical appearance of the area is similar to the North Cambridge and Agassiz Neighborhoods, with two-, three- and four-story residential structures predominating. A mixture of commercial activity along the streets in the area is oriented to neighborhood consumers.

Land Use

Land use issues facing the Agassiz Neighborhood are: the expansion of Harvard University and Lesley College; specific institutional plans for the Sachs Estate and Sacramento Street; potential Porter Square redevelopment as part of the Red Line Extension; and the appropriateness of C-3 zoning for general institutional (and private development) activity.

The primary land use issues in Neighborhood Nine relate to: the future of the western industrial area; potential develop-

ment alternatives for the dump; development pressures in the Harvard-Radcliffe area; the future of commercial and residential development on Massachusetts Avenue; and the utilization or treatment of the MBTA Fitchburg Main Line railroad right-of-way.

Issues facing North Cambridge are: the potential acceleration of development resulting from the placement of two Red Line stations at either end of the neighborhood--Porter Square and Alewife; an acceptable method of integrating the Boston and Maine railway corridor into the neighborhood; and the future of the declining industrial areas. Chapter VI discusses the issues concerning the western end of the neighborhood near the Alewife Station.

Population

The Agassiz Neighborhood, has a population of 5,146, a decrease of 12.5 percent since 1960 as compared with the citywide decrease of 6.8 percent. It has experienced a decrease in household size not unlike the general trend for Cambridge as a whole. From 1950 to 1970 the segment of the population living in a family situation decreased by nearly one-half, while the population living in non-family households--individuals living by themselves or with non-related roommates -- morethan tripled during the same time. The population living in group or dormitory quarters has remained approximately constant in size, although as a percentage of the population it has increased.

The population of Neighborhood Nine has also been declining, along with that of the city, over the past ten years. During the 1950's, families were replaced at a moderate rate by young immigrants; the elderly population tended to remain stable. Between 1950 and 1970, the number of families decreased to two-thirds its original number while the non-family population increased over 100 percent. This influx of young people decreased the number of persons per occupied unit and increased the number of occupied units.

North Cambridge population decreased one percent between 1960 and 1970, but the older areas, especially around Porter Square, are declining at a faster rate. Most new residents are

renters and are concentrated in Rindge Towers in the Alewife area. Out of 4,549 North Cambridge households in 1970, 29 percent (1,318) were students, young professionals and single people; in 1960, these single households were only 15 percent of the total and while the number of non-family households in North Cambridge has more than doubled, it is still lower than the city average. The most noticeable characteristic is the population stability, with almost 60 percent of the homeowners established in the neighborhood before 1959.

The Spring Hill and Ward Two Neighborhood areas in Somerville had populations of 13,059 and 11,554 respectively in 1960, for a combined total of 24,613. Approximately 7,730 persons, or 31 percent, were under the age of 18; 2,680 persons, or 11 percent, were over 65 years; and 436 or 4 percent were minorities.

Total population in 1970 for the areas of Cambridge and Somerville within one-half mile walking distance from the proposed Porter Square Station was approximately 11,177, of which 2,469 persons, about 22 percent, were under the age of 18. Approximately 1,865 persons, or 17 percent, were over 65.

Housing Units

The Agassiz Neighborhood has one of the highest proportions of renter- to owner-occupied housing units in Cambridge according to the 1970 census. In 1972 the City of Cambridge surveyed exterior conditions of structures in Agassiz and only 5.3 percent were in need of extensive rehabilitation.

Compared to other areas in Cambridge, Neighborhood Nine has a relatively moderate level of renter-occupied dwelling units. Neighborhood Nine's housing stock is in excellent condition. The conversion of dwelling units as well as the majority of new construction in this area has been for use as rental property.

North Cambridge in 1970 had a high level of owner-occupied dwelling units. During the 1950 to 1970 period, the total number of housing units increased by 22.5 percent; the number of renters increased by 36.8 percent; and ownership decreased two percent.

In 1960, Somerville's Spring Hill and Ward Two neighborhoods had high levels of owner-occupied units (33 percent), and renter-occupied units (64 percent). In 1970 there were a total of 4,531 dwelling units within a half mile walk of the proposed station. Of this total, 499 or 11 percent were single-family homes.

The following table shows the comparative characteristics relative to the ratio of homeowners to renters, and also compares the median property values and rents for the neighborhoods discussed in the previous paragraphs.

Table IV-9

HOUSING CHARACTERISTICS
(1970 Census)

Neighborhood	Owner-Occupied Single-Family Units (Percentage)	Median Value*	Rental Units (Percentage)	Median Rental**
Agassiz	12.7	$41,300	84.5	$143
Neighborhood Nine	19.8	45,325	80.0	140
North Cambridge	28.0	18,697	68.9	108
Spring Hill and Ward Two	24.0	30,300	74.0	139

* Cambridge Average - $24,700
** Cambridge Average Rental - $119

Family Income

The major employers in the Porter Square area are the Sears Roebuck and Co. department store and the Porter Square Shopping Center area. In 1972, a total of approximately 883 jobs[1] were provided in the Porter Square area, mostly by small businesses employing less than 50 persons. Work force breakdowns for

1 City of Cambridge, Office of Economic Development and Manpower

the Spring Hill and Ward Two areas of Somerville, although not available, are similar to those of the North Cambridge Neighborhood.

Unemployment for 1970 was 5.9 percent in Neighborhood Nine and 6.5 percent in North Cambridge, compared to the City of Cambridge average of 8.5 percent. In 1974, unemployment in the Agassiz Neighborhood was 6.3 percent.

In addition to comparing median family incomes for the three Cambridge neighborhoods that would fall within the sphere of influence of the Porter Square Station, the following table breaks the total work force down, by percentages, into three broad categories of workers: professional, white collar and blue collar.

Table IV-10

FAMILY INCOME
(1970 Census)

Neighborhood	Median Family Income*	Total Work Force	Professional (Percentage)	White Collar (Percentage)	Blue Collar (Percentage)
Agassiz	$ 11,525	2,701	51	35	14
Neighborhood Nine	12,217	5,547	43	39	18
North Cambridge	9,609	5,942	22	36	42

*Citywide Average - $9,815

Parking

Parking in all neighborhoods surrounding Porter Square is limited, due to the high level of urbanization in Cambridge and Somerville. Some portions of Neighborhood Nine and Agassiz have especially critical parking situations due to the concentration of educational and commercial facilities in the general Harvard Square area. In the residential areas near Harvard Square, a sticker program was recently instituted and will soon be expanded to include the entire city. Similar parking controls do not exist in Somerville,

but a residential sticker program is presently being studied.

Pedestrian Circulation

Over one-half of the residents in the Porter Square area use public transportation for travel to work. While they have reasonably good access to the buses and trackless trolleys in Porter Square, walking to the loading areas involves the crossing of major traffic routes such as Massachusetts and Somerville Avenues. The commuting habits of neighborhood residents, according to the 1970 census, were as follows:

Table IV-11

METHOD OF TRANSPORT TO WORK
(Percent)

Neighborhood	Walking	Automobile	Public Transport
Agassiz	22.2	37.6	33.6
Neighborhood Nine	28.5	46.9	18.6
North Cambridge	22.0	58.0	14.0
City of Cambridge	25.5	41.9	26.5

Over the years the localized commercial activities in the Porter Square area have developed a significant pedestrian-oriented group of consumers in adjacent neighborhoods. As the major commercial activites are separated by roads with heavy volume of traffic, it is difficult to shop in Porter Square without crossing Massachusetts Avenue, Somerville Avenue or Elm Street, the most hazardous vehicular-pedestrian conflict points in Porter Square.

Public Facilities and Services

The Agassiz Neighborhood has fewer public facilities than any of the Cambridge neighborhoods. There is no public open space in the area and the Agassiz Elementary School has the only recreation facility, a small playground. Although the Sachs Estate is a major open area, it is presently owned by Harvard University and is not accessible to the public. Sacramento Field, also owned by Harvard University is presently accessible to the public, but it may be developed in the future.

Neighborhood Nine, with a large amount of open space, has only a moderate amount of recreational development. Developed areas include St. Peter's Field, Corcoran Playground, the Peabody Elementary School Playground, and the Cambridge Common. However, a major opportunity for open space development exists at the site of the dump. The only public school facility in this neighborhood is the Peabody Elementary School.

North Cambridge has two large recreational areas--the 7.5 acre Rindge Field, and Russell Field with 9.8 acres. Three smaller areas include Cogswell Playground, 0.7 acres; Parkway Totlot, 0.1 acres; and the MDC swimming pool. Various indoor activities are available through the Community School Program. Although 18.6 acres are used for recreational purposes in North Cambridge, it is one of the city's more recreationally deficient neighborhoods.

Somerville's Spring Hill and Ward Two Neighborhoods have several recreational facilities, principally the Lincoln and Conway Athletic areas and Bailey Park. Area elementary schools, such as the John F. Kennedy Elementary School near Porter Square, provide playground areas.

Impacts

Neighborhoods

The Red Line Extension would have no adverse short-term effect on the physical appearance of adjacent neighborhoods. Construction activities would temporarily alter the appearance of the Porter Square commercial area, but no significant long-term change is expected as a result of surface station facilities.

Opening of the proposed station could accelerate the long-term commercial and high density residential development in Porter Square, as discussed in the Land Use section of this chapter. High density residential development, by providing additional rental units, would tend to increase the total population in the Porter Square area. Since those persons boarding the Red Line Extension at Porter Square are expected to be local people, there is little potential for significant changes in the type of local retail activity in the area.

Property values in the Porter Square area can be expected to increase following construction and opening of the Red Line Extension and average monthly rentals would also be adjusted upward. However, compared to areas adjacent to other stations on the Red Line Extension, the total increase is not expected to be great. This assumption is based on the lower number of boardings anticipated at the Porter Square Station, the local orientation of the station, and the desire of neighborhood groups to limit the scale of commercial and high density residential development in Porter Square.

Traffic and parking impacts and mitigating measures are discussed in detail in the Traffic and Transportation section. During the time parking spaces are displaced in the shopping centers, demands on existing residential and commercial parking areas could temporarily increase, but it would not be necessary to detour traffic.

Jobs Affected

Relocation of the six Porter Square businesses described in the Land Use section would involve approximately 10 to 20 employees. Employees of those businesses relocated within Porter Square would experience few, if any, adverse effects, but relocations outside of Porter Square could require greater travel time to work. A loss of jobs would, of course, result if any of the displaced businesses ceased operations.

Community Facilities

Community facilities in the area could benefit from the increased accessibilility provided by close proximity to a Red Line station. The potential service areas would be increased for many of these facilities and the line segment tunnels and station would not adversely affect existing service areas.

Mitigating Measures

Rezoning downward or height limitations could be considered as one method of reducing the potential for significant changes in the commercial activities and high-rise residential developments. This was discussed in the Land Use section.

Increased parking demand around the proposed station could be monitored by the expansion of the City of Cambridge resident sticker program and adequate police enforcement. The City of Somerville could also consider adopting similar resident parking restrictions to avoid the spillover of the commuter-oriented parkers forced out of Cambridge as a result of the parking sticker program.

HISTORIC RESOURCES

Existing Conditions

Eight buildings of historic significance have been identified in the immediate vicinity of the proposed alignment within this section. In a survey prepared by the Cambridge Historical Commission, the historic resources were classified in four categories according to their relative architectural and social value. The four categories are:

> Primary Importance: Generally those structures of outstanding value. They are considered worthy of nomination or are already included in the National Register of Historic Places.

Very Important: Structures of slightly less significance and age.

Important and Moderately Important: Buildings of local significance but not currently under consideration for submission to the National Register.

Determinations were based on architectural integrity as well as the significance, incidence, or scarcity of structures of a particular style or period, or designed by a specific architect.

The historic structures within the zone of potential influence of one or more of the transit alternatives between Cambridge Common and Porter Square include:

1. 1627 Massachusetts Avenue. This 1862 building on the east side of the avenue at the corner of Mellen Street is an example of Mansard style and has been classified Moderately Important. It is considered necessary to the retention of the avenue's domestic scale.

2. 1626 Massachusetts Avenue. Located on the west side of the avenue near Langdon Street, this 1868 building has also been classified Moderately Important as a good example of Mansard style. It is considered important to the domestic scale of this stretch of Massachusetts Avenue.

3. 1705 Massachusetts Avenue. Designed by Van Brunt and Howe and completed in 1889, this building is a good example of the Colonial Revival style. It has been classified as Moderately Important, and is considered important to the avenue's domestic scale.

4. 1734 Massachusetts Avenue. Located on the west side of Massachusetts Avenue just south of Linnaean Street, this 1885 example of Queen Anne style has been classified Moderately Important. Like its neighbors, it is considered important to the domestic scale of the avenue.

5. 1776 Massachusetts Avenue. Between Lancaster Street and Stone Court, this 1885 building is also of Queen Anne style. It has been classified Moderately Important and necessary to the scale of the avenue.

6. 1803 Massachusetts Avenue. The North Avenue Congregational Church on the east side of Massachusetts Avenue at Roseland Street is of Primary Importance and is expected to be a National Register nominee. Built in 1845 and designed by Architect Isaac Melvin, this handsome Egyptian-Greek Revival church is an essential visual focus and important landmark in North Cambridge.

7. 1815 Massachusetts Avenue. G.C. Nimmons' store for Sears Roebuck and Co. is located along the east side of Massachusetts Avenue between Roseland Street and Somerville Avenue. Constructed in 1928, it is an early example of Art Deco style, and provides visual focus for the avenue. It has been classified Moderately Important.

8. 1847-53 Massachusetts Avenue. This fine brick business block, completed in 1882, still has its original detailing. It defines the commercial district of Porter Square as an urban streetscape and has been classified Important.

Impacts

Construction by the tunnel/deep bore method well below the existing land surface is proposed for this section. As a result, no taking or destruction of historic resources is anticipated. The activities in a group of brick business buildings at 1847-53 Massachusetts Avenue may be disrupted for a short time due to station construction, but no structural or long-term impacts are expected. Vent and relief shafts would be located several hundred feet from any historic building and no impacts are expected.

There is a possibility that the historic buildings could experience settling and other structural impacts from foundation vibrations during construction in the tunnel below. In addition, noise and dust resulting from the construction could have a negative esthetic impact on the structures.

Mitigation

All historic structures will be closely monitored during the construction process and will be examined periodically following completion. In the event that damage appears, appropriate repairs would be made in keeping with the authentic character of the structure. Ongoing coordination with the Cambridge Historical Commission would be maintained throughout the construction process to assure an absolute minimum of disruption.

NOISE AND VIBRATION

Ambient Noise Conditions

Noise levels can be characterized as constant during the midday hours, with a gradual fall of 10 dBA during nightime hours. The diurnal noise pattern is similar to that at Davis Square as shown in Figure V-8. Short-term measurement in Porter Square at noon March 5, 1975 showed the high noise levels characteristic of heavy traffic in the city center (See Table IV-12). The results are summarized below:

Along Massachusetts Avenue: See Chapter III.

Porter Square: Diurnal pattern: See Figure V-8
Short-term: noontime L_{eq} = 71 dBA
L_{10} = 75 dBA
L_{50} = 69 dBA
L_{90} = 65 dBA

Table IV-12

SHORT-TERM NOISE MEASUREMENTS NEAR PORTER SQUARE

Site No.	Location	Time	Levels (d BA) L_{eq}	L_{10}	L_{50}	L_{90}
16	Lincoln School	13:30	53	57	51	45
17	Porter Square	12:00	71	75	69	65

See Figure II-1B & C for locations of noise measurement sites.

Future Noise From Transit Operations

Line Segment Operations

The line segment between Harvard Square and Porter Square will be in tunnel/deep bore. Problems associated with airborne noise will therefore be eliminated except during the construction of the ventilation and emergency shafts.

Stations

The Porter Square Station could affect the local noise levels through induced surface traffic in the vicinity of the station. Train noise is not expected to be a significant community problem since the proposed station is below grade.

Vibrations

Ground vibrations are expected to be similar in level to those reported in Chapter III for Harvard Square. With the use of welded rail and floating slabs, vibration levels in buildings along Massachusetts Avenue adjacent to the subway will be below the threshold of human perception. However, ground vibrations caused by the passage of trains in the subway tunnels may cause the walls of these buildings to radiate a rumbling noise. Therefore, special trackwork will be used throughout the section.

Assessments

Absolute Assessment

None of the surface criteria levels are expected to be exceeded by subway operations along this segment. Ventilation and emergency shafts should be designed for quiet operation and located at non-sensitive sites.

Changes in Noise Level

Existing noise levels should not be affected by train operations or by station activities in this section of the Red Line Extension.

Noise Control Techniques

Ventilation and emergency shafts will be designed to reduce the noise from passing trains which would otherwise reach the community through these openings.

AIR QUALITY

Areawide air quality impacts were discussed in Chapter II, and the following discussion is restricted to loclized CO effects in the vicinity of Porter Square Station. The details of the analytical methodology and the results are presented in Chapter III of Appendix H. The analytical method considered the effects of induced traffic at the station in making air quality projections.

The predicted levels of carbon monoxide in the vicinity of the Porter Square Station in the 1974 base year, 1980 no-build case, and the three build alternatives are given in Table IV-13. Note that there are no adverse air quality impacts for any of the build cases in comparison with the no-build case, and 1980 CO levels show a marked reduction over 1974 levels for all cases.

Table IV-13

PREDICTED CARBON MONOXIDE CONCENTRATIONS (PPM)
IN THE IMMEDIATE VICINITY OF THE PORTER SQUARE STATION

Meteorological Condition	Averaging Period	1974	1980: No Build Case	1980: Build Case Termination at: Route 128	Arlington Heights	Alewife
Worst Case	8 Hours	8.9	4.4	4.4	4.4	4.4
	1 Hour	14.4	7.1	7.1	7.1	7.1
Most Probable	8 Hours	1.9	1.0	1.0	1.0	1.0
	1 Hour	2.5	1.3	1.3	1.3	1.3

CONSTRUCTION IMPACTS

The major adverse impacts of construction would be air and noise pollution, traffic disruptions, maintenance or relocating of utilities, siltation and erosion, effect on existing structures, disposal of excavated materials, spill age, effects on groundwater table and possibility of encountering an underground stream. A discussion of the general construction impacts can be found in Chapter II. The remaining portion of this section discusses specific construction impacts applicable to this segment.

Traffic Disruption

Maintenance of vehicular traffic on Somerville Avenue, parking at Porter Square Shopping Center and railroad operations along the Fitchburg Division will be major factors during the construction period. It is anticipated that traffic could be maintained by decking and that the railroad tracks can be supported. For further discussions turn to Page IV-6 and IV-26.

It is proposed that a construction shaft for the tunnel deep bore portion of the project, be located adjacent to the Fitchburg Division tracks at Porter Square. It is anticipated that short haul roads might be built along the railroad tracks toward Alewife. The need and extent of the roads will be established in the pre-grant engineering phase. Roads should not interfere with railroad operations. For further discussion see Chapter II and Pages IV-26 and IV-30.

Effect on Existing Structures

It is anticipated that underpinning may be required of certain buildings at the Porter Square Station such as the Harvard Trust/Commonwealth Lock Building.

Utilities

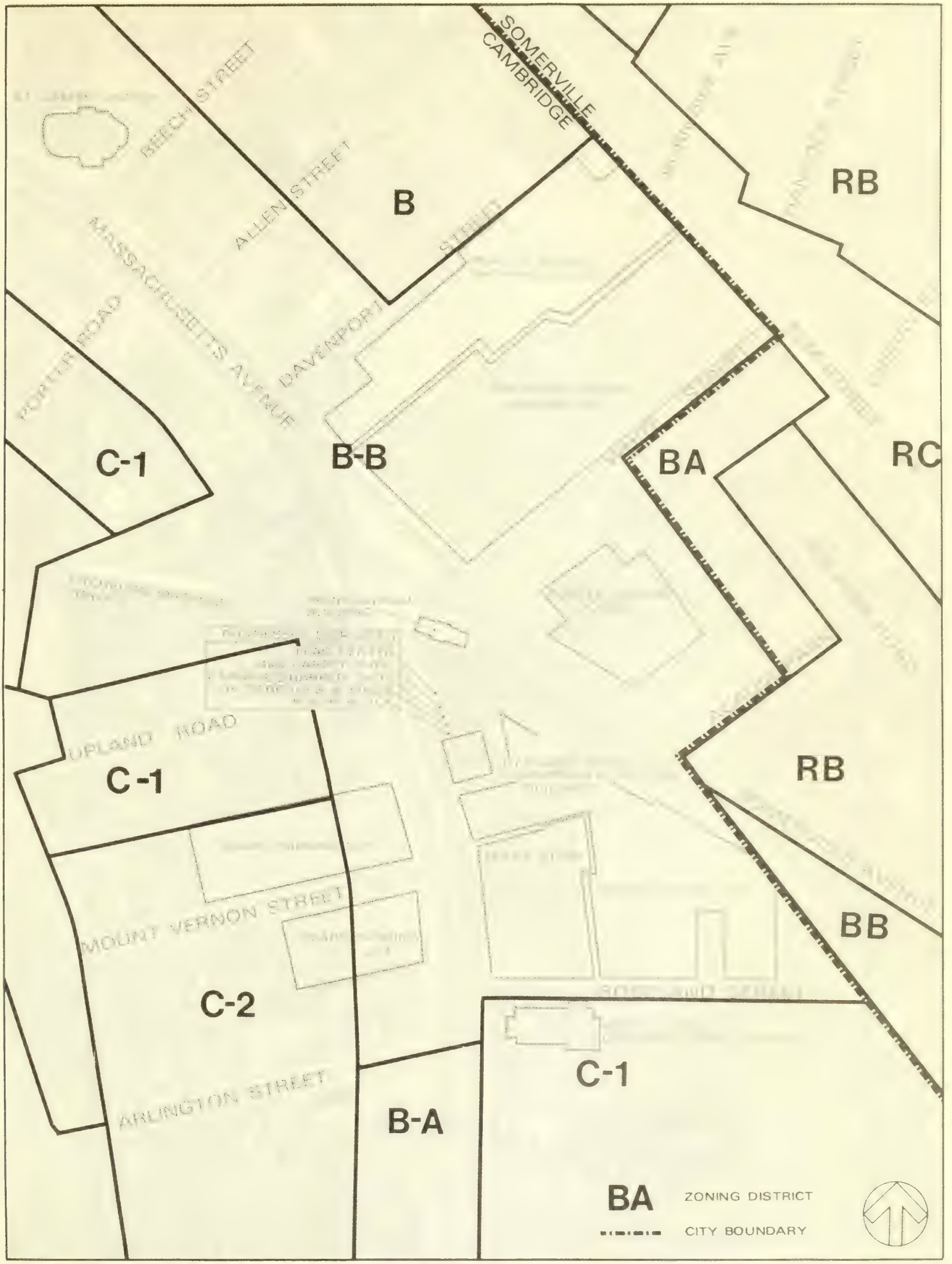
Several utilities will be relocated or maintained. Turn to Page IV-7 for further discussion.

Disposal of Excavated Materials

Excavated material amounting to 250,000 cubic yards is anticipated for the Harvard- Davis tunnel/deep bore.

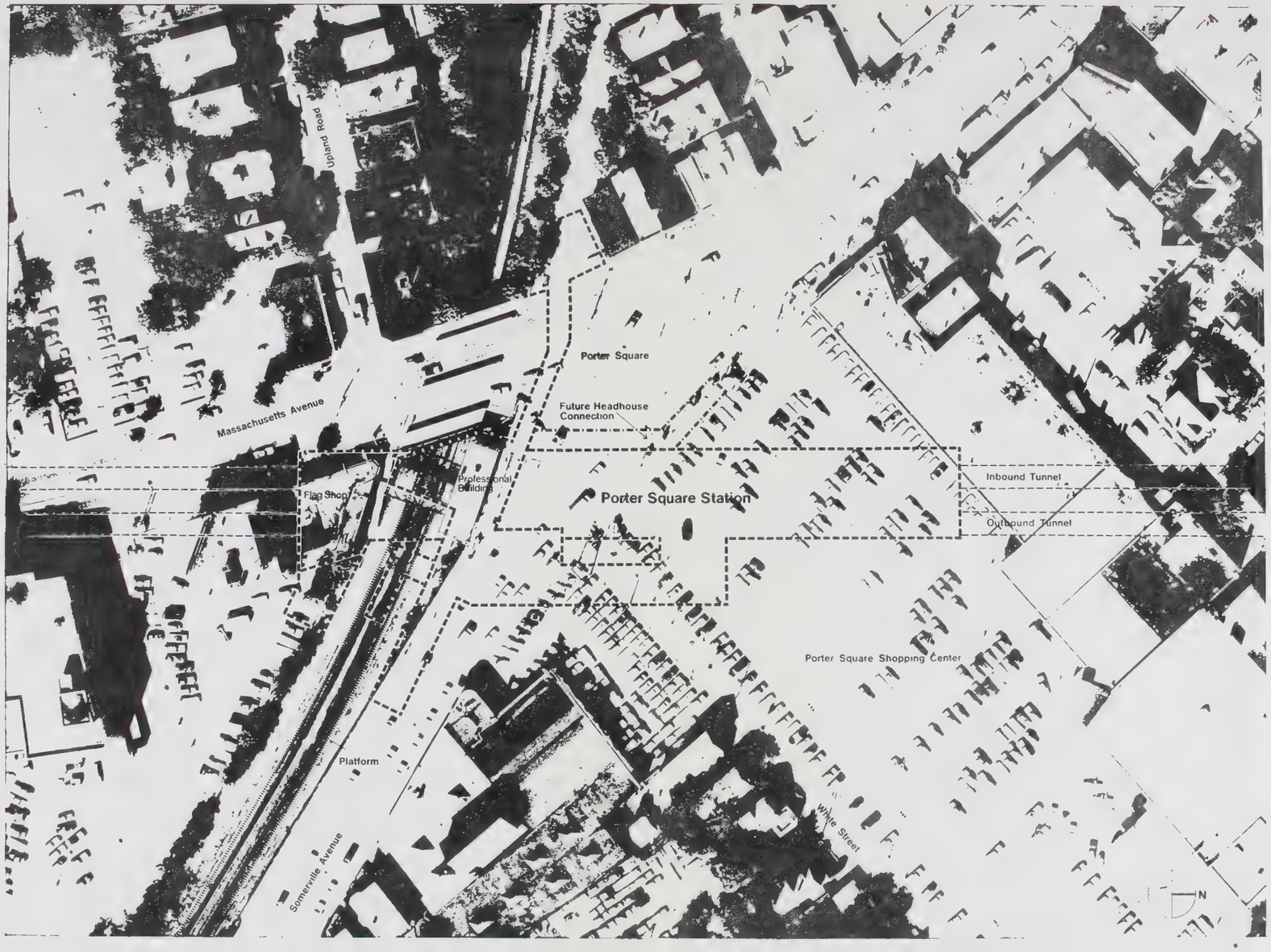
Historic Resources

No taking or destruction of historic resources is anticipated. For a discussion turn to Page IV-43 and IV-44, "Impacts" and "Mitigation" (Historic Resources).



RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

PORTER SQUARE
EXISTING CONDITIONS
FIG. IV-1



Porter Square Station

Schematic Design/Red Line Extension NW

Cambridge Seven Associates
6 April 1977

RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

PORTER SQUARE
AREA PLAN
FIG. IV–2

West Headhouse
Left Turn Lane
Benches
Upland Road
Bus Stop #77,TT77
Massachusetts Avenue
Existing Curbline
Bus Stop #14
Future Headhouse Connection
Porter Square Shopping Center
East Headhouse
Bus Stop #77,TT77
Possible Joint Development Above
Elev
Elev
Bus Shelter
Relief Shaft
Commonwealth Lock Building
Bus Shelter
Bus Stop #14
Platform Canopy
Relief Shaft
Somerville Avenue
White Street
N
0 20 feet

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
RED LINE EXTENSION NW HARVARD TO DAVIS
CONTRACT NO. 065-001

Site Plan

CAMBRIDGE SEVEN ASSOCIATES INC
1050 MASSACHUSETTS AVE
CAMBRIDGE MASS 02138

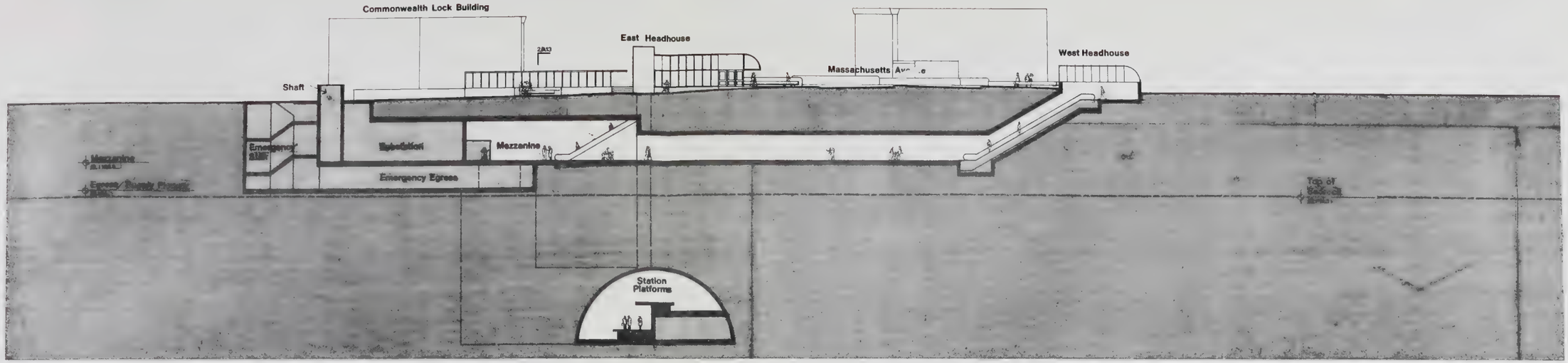
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
APPROVED BY
PROJECT MANAGER

ISSUE	DATE	DESCRIPTION	BY	CHKD	APP

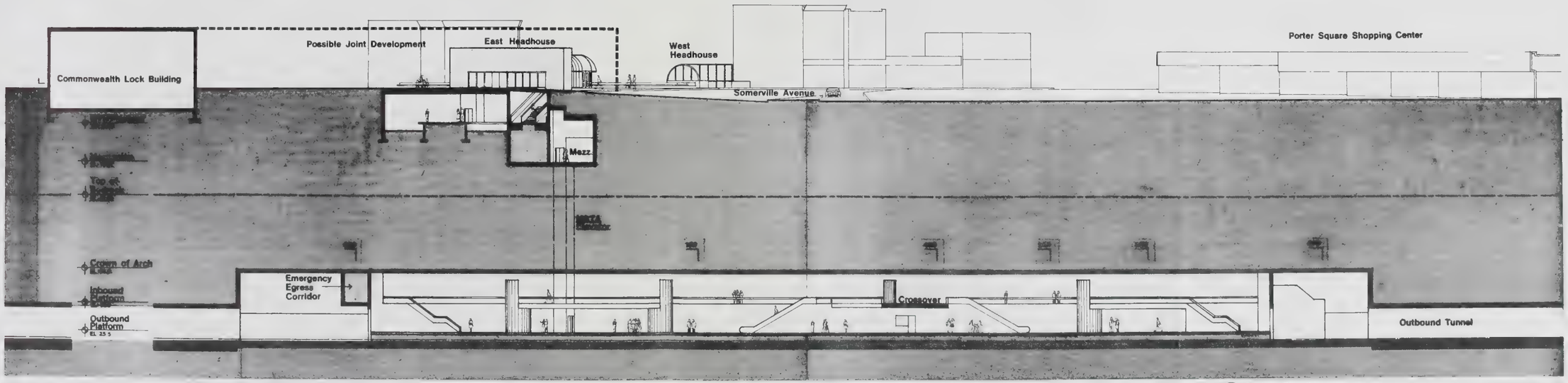
SCALE 1" = 20'
DRAWN BY | DESIGN BY | CHECK BY
PLAN NO
DATE 4/6/77
SHEET A2 OF
ISSUE

RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

PORTER SQUARE
SITE PLAN
FIG. IV-3



1 Transverse Section



2 Platform Elevation

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

RED LINE EXTENSION NW-HARVARD TO DAVIS
CONTRACT NO. 065-001

Transverse Section
Platform Elevation

CAMBRIDGE SEVEN ASSOCIATES, INC.
1050 MASSACHUSETTS AVE
CAMBRIDGE, MASS. 02138

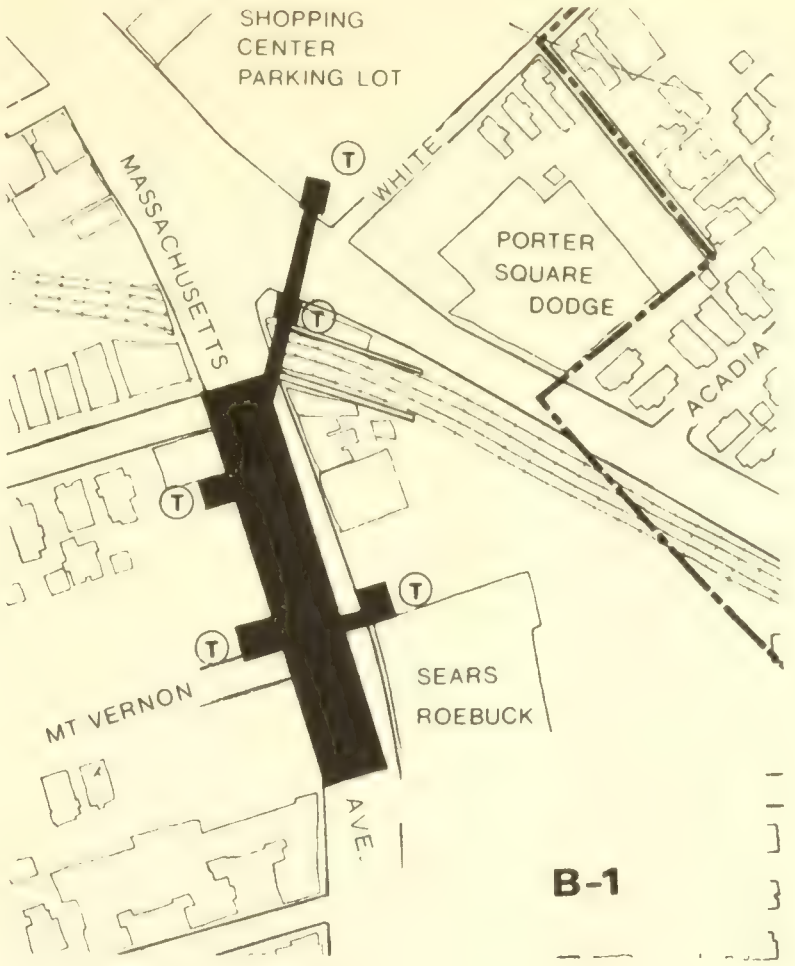
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
APPROVED BY
PROJECT MANAGER

ISSUE	DATE	DESCRIPTION	BY	CHKD	APP

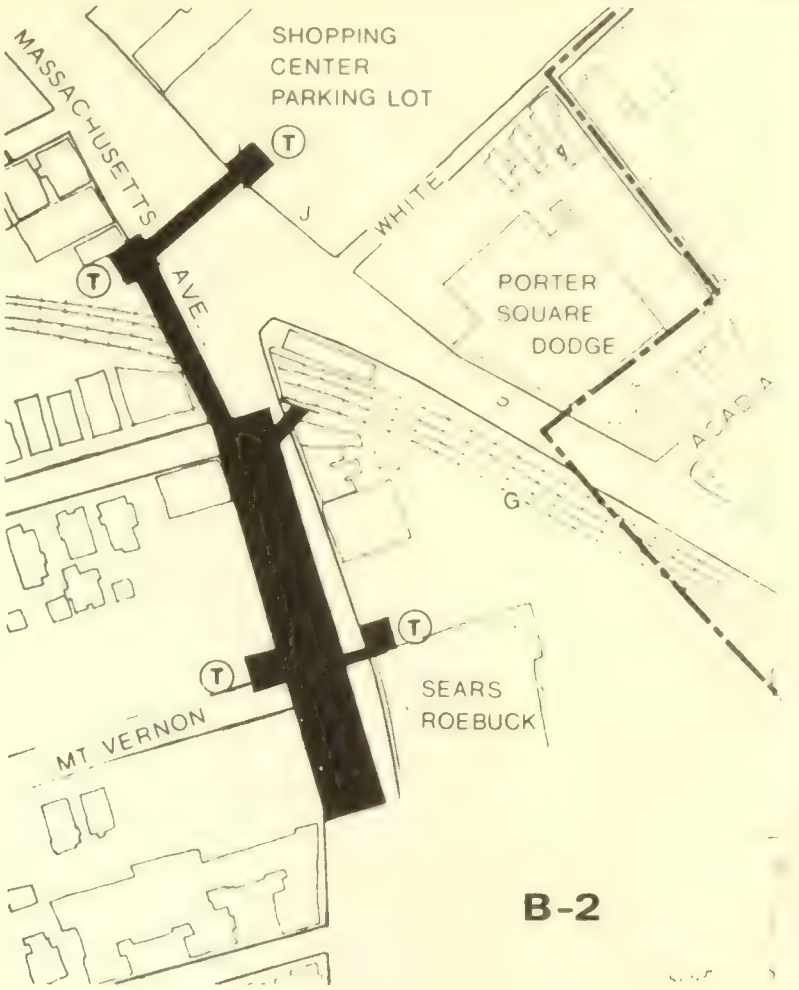
SCALE 1" = 20'
DATE 4/6/77
DRAWN BY
DESIGN BY
CHECK BY
PLAN NO.
SHEET A7 OF

RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

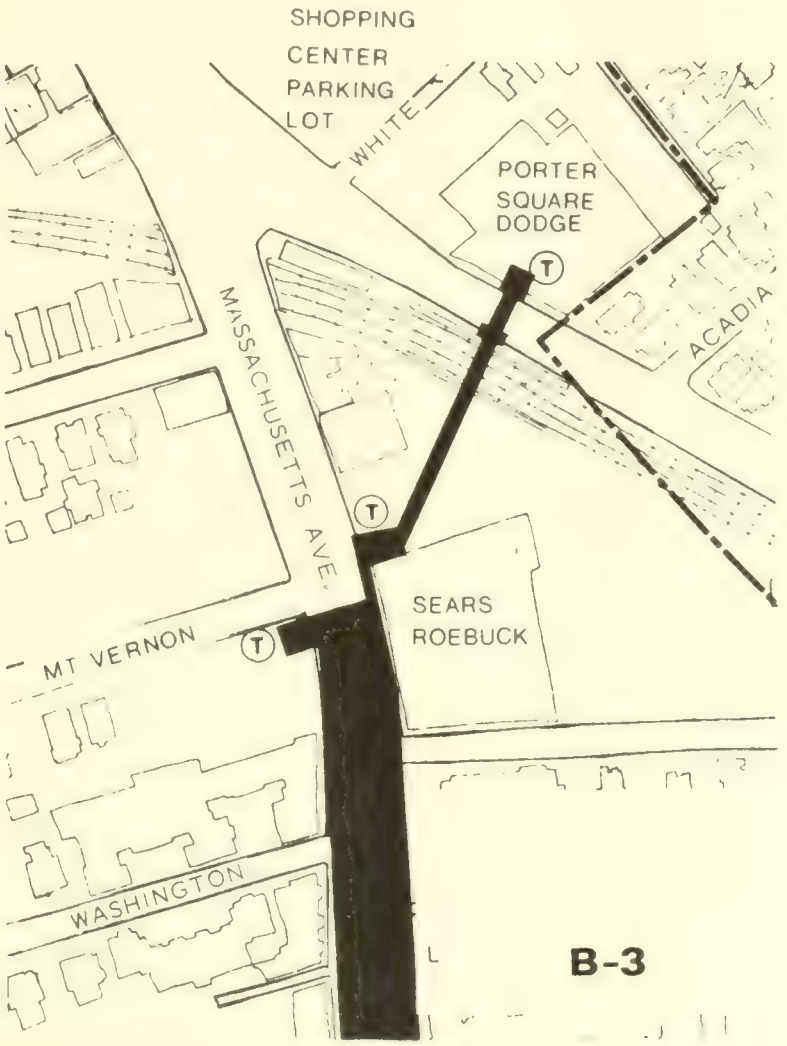
PORTER SQUARE
SECTIONS
FIG. IV-4



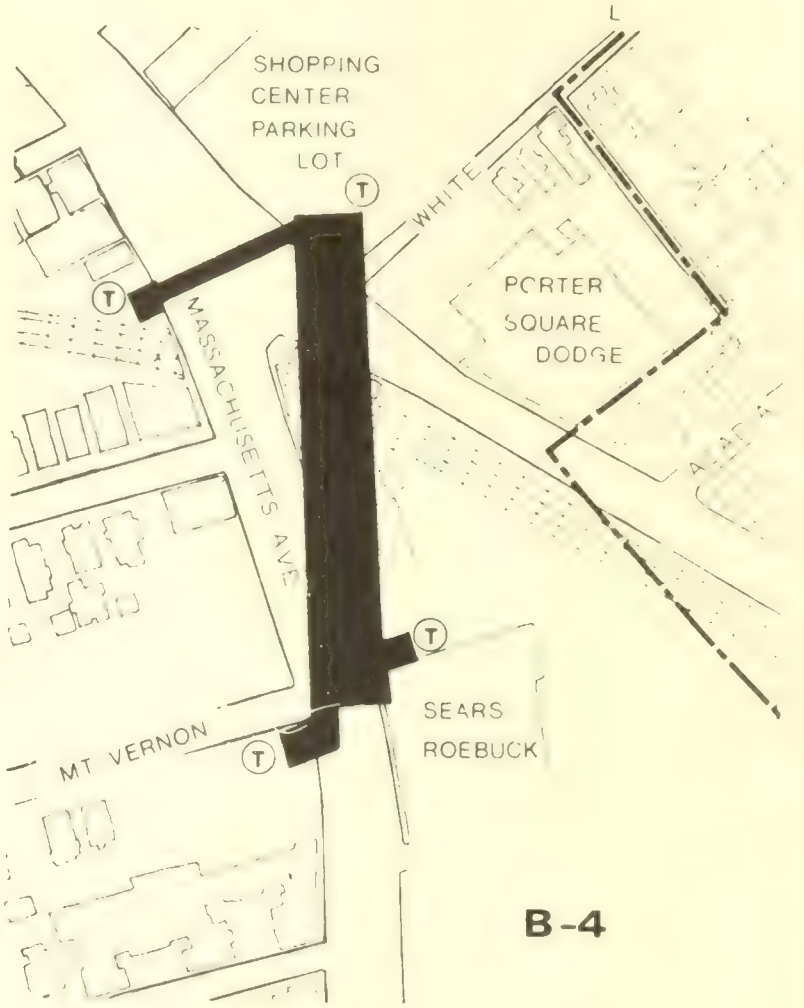
B-1



B-2



B-3



B-4

STATION LOCATION

T ENTRANCE/EXIT

Massachusetts Bay Transportation Authority

PORTER SQUARE
TAG STATION LOCATION ALTERNATIVES

FIG. IV – 5

Chapter V

PORTER SQUARE TO DAVIS SQUARE

Chapter V

PORTER SQUARE TO DAVIS SQUARE

PROJECT DESCRIPTION

Line Segment

Beginning at the Porter Square Station, the alignment would continue north toward Somerville through a short, 4,000-foot radius curve followed by a long tangent section in Somerville. After crossing under Hawthorne Street, the alignment would turn west through a 700-foot radius curve onto the MBTA's Freight cutoff of the South Acton Commuter Rail Line and into Davis Square. See Figures II-IB and C.

At Porter Square, the tracks would be about 105 feet below grade. The vertical grades would be mild throughout the segment and for deep bore construction the profile should be kept at these levels to take best advantage of the rock conditions. From Porter Square Station, the tracks would ascend initially at minimum grade to about Hawthorne Street and thence at close to maximum allowable grade to Davis Square Station. The soils profile indicates an area between Grove Street and the Davis Square Station where the tunnel would go through a "mixed-face" soils condition--the tunnel face would be excavated through part clay or till and part rock (argillite).

A ventilation and emergency shaft would be situated on private property on Summer Street.

The BTPR Study considered two possible alignments for the subway from Porter Square to Davis Square. The alignment selected during this study closely corresponds to the BTPR's alignment 3B, and is considered to be geometrically compatible with the location of a station at Davis Square.

Station

The proposed Davis Square Station would be located almost entirely within the right-of-way of the Freight Cutoff. See Figures V-2 and V-3. It would extend from approximately 145 feet east of College Avenue to about 195 feet west of Holland Street. The station would be approximately 540' x 69' with a 440' long platform and would consist of two levels--the mezzanine, which is the first level below the street, and the platform, located below the mezzanine. See Figures V-3 and V-4.

Two street level entrances would afford pedestrian and bus transfer access to the mezzanine area. One entrance would be located on the west side of Holland Street and one entrance would be located east of College Avenue in the vicinity of the bus loading/unloading area.

An elevator would be located on the bus loading/unloading platform to permit barrier-free entry from the street to the mezzanine and platform levels.

Escalators and stairways would be located at all entrances to provide access to the mezzanine level, as well as to the platform. There would be one up and one down escalator from each entrance to the mezzanine. The escalators from the mezzanine to the platform would be fixed in the rush-hour direction during the morning and evening peak hours, but could be user-activated in either direction during off-peak hours.

The fare collection area would be located on the mezzanine with turnstiles and two ticket booths staffed by MBTA personnel.

Ticket booths would be located to permit maximum surveillance of public areas and entrances to optimize personal security. The platform level would be visible from ticket booths.

A bus loading/unloading area--consisting of two lanes between College Avenue and Grove Street and four bus spaces--would be located directly above the College Avenue side of the station. Bus movements would be from east to west with a passenger loading island between the two lanes.

A station entrance would be located adjacent to the bus loading/unloading area; the elevator would be located in the College Avenue entrance. Figure V-3 illustrates the proposed bus loading/unloading area.

Air relief shafts would be required at both ends of the station to reduce the rushing effect of air pushed in front of a train in a tunnel. These shafts would be incorporated into the station design. The shaft on the east side of the station could be incorporated into the design of the bus shelter, while at the other end, the shaft could be incorporated within the parking area and covered with a vent grating.

Right-of-Way

Between the Porter Square Station and the Davis Square Station, the subway would be constructed under private properties by the tunnel/deep bore method which would require a number of permanent easements. Construction of the Davis Square Station would also require several property takings. Table V-1 lists these right-of-way requirements.

Table V-1

RIGHT-OF-WAY REQUIREMENTS
PORTER SQUARE TO DAVIS SQUARE

Address	Type	Use
Cambridge		
1-3 Orchard Street	Residential	Permanent Easement
2-4 Orchard Street	Residential	Permanent Easement
9 Orchard Street	Residential	Permanent Easement
11 Orchard Street	Residential	Permanent Easement
13-15 Orchard Street	Residential	Permanent Easement
17 Orchard Street	Residential	Permanent Easement
2-6 Saginaw Avenue	Residential	Permanent Easement
12 Saginaw Avenue	Residential	Permanent Easement
16-22 Saginaw Avenue	Residential	Permanent Easement
140 Elm Street	Residential	Permanent Easement
24 Beech Street	Residential	Permanent Easement
22 Beech Street	Residential	Permanent Easement

Table V-1 (Continued)

RIGHT-OF-WAY REQUIREMENTS
PORTER SQUARE TO DAVIS SQUARE

Address	Type	Use
Somerville		
4 Willow Avenue	Residential	Permanent Easement
8-10 Willow Avenue	Residential	Permanent Easement
151 Elm Street	Residential	Permanent Easement
153-155 Elm Street	Residential	Permanent Easement
157 Elm Street	Residential	Permanent Easement
161-163 Elm Street	Residential	Permanent Easement
5-7 St. James Street	Residential	Permanent Easement
9-9A St. James Street	Residential	Permanent Easement
14 St. James Street	Residential	Permanent Easement
16 St. James Street	Residential	Permanent Easement
20 St. James Street	Residential	Permanent Easement
22 St. James Street	Residential	Permanent Easement
26 St. James Street	Residential	Permanent Easement
21 Windom Street	Residential	Permanent Easement
11 Elston Street	Residential	Permanent Easement
15 Elston Street	Residential	Permanent Easement
19 Elston Street	Residential	Permanent Easement
23 Elston Street	Residential	Permanent Easement
25-27 Elston Street	Residential	Permanent Easement
24 Elston Street	Residential	Permanent Easement
344-344A Summer Street	Residential	Permanent Easement
346-348 Summer Street	Residential	Permanent Easement
345-349 Summer Street (Vent Shaft)	Residential	Partial Taking/Permanent & Construction Easements
351-357 Summer Street	Private Parking	Permanent & Construction Easement
44 Hawthorne Street	Residential	Permanent Easement
46-46A Hawthorne Street	Residential	Permanent Easement
48-50 Hawthorne Street	Residential	Permanent Easement
52-54 Hawthorne Street	Residential	Permanent Easement
49-51 Hawthorne Street	Residential	Permanent Easement
53-55 Hawthorne Street	Residential	Permanent Easement
57-59 Hawthorne Street	Residential	Permanent Easement
56 Hawthorne Street	Residential	Permanent Easement
7 Elston Street	Residential	Permanent Easement
385 Highland Avenue	Residential	Permanent Easement

Table V-1 (Continued)

RIGHT-OF-WAY REQUIREMENTS
PORTER SQUARE TO DAVIS SQUARE

Address	Type	Use
Somerville (continued)		
23-25 Cutter Avenue	Residential	Permanent Easement
27-29 Cutter Avenue	Residential	Permanent Easement
31-33 Cutter Avenue	Residential	Permanent Easement
378-382 Highland Avenue	Residential	Permanent Easement
384-384A Highland Avenue	Residential	Permanent Easement
386 Highland Avenue	Residential	Permanent Easement
387-389A Highland Avenue	Residential	Permanent Easement
393 Highland Avenue	Commercial	Permanent Easement
Grove Street @ Highland Avenue	Parking	Permanent Easement
401 Highland Avenue	Commercial	Permanent & Construction Easements
403-405 Highland Avenue	Commercial	Permanent & Construction Easements
Rear 407 Highland Avenue	Commercial	Permanent & Construction Easements
Rear 409-411 Highland Avenue	Commercial	Partial Taking/Permanent, Utility & Construction Easements
421-431 Highland Avenue	Commercial	Construction Easement
30 Ellington Road	Residential	Permanent Easement
42 Grove Street	Residential	Permanent Easement
1 College Avenue	Commercial	Total Taking
11-15 College Avenue	Vacant Land	Total Taking
17-21A College Avenue	Commercial	Construction Easement
Rear 17-21A College Avenue	Commercial	Partial and/or Total Taking Construction Easement
16 Holland Street	Commercial	Total Taking of Land and Structure
18-24 Holland Street	Commercial	Construction Easement
26-30 Holland Street	Commercial	Construction Easement
32 Holland Street	Commercial	Construction Easement
18 Winter Street	Commercial	Construction Easement
12-16 Winter Street	Commercial	Construction Easement
12-14 College Avenue	Commercial	Construction Easement

Table V-1 (Continued)

RIGHT-OF-WAY REQUIREMENTS
PORTER SQUARE TO DAVIS SQUARE

Address	Type	Use
Somerville (continued)		
5-17 Holland Street	Commercial	Construction Easement
45-48 Davis Square	Commercial	Total Taking of Land and Structure
3 Holland Street	Commercial	Construction Easement
296-304 Elm Street	Commercial	Construction Easement
79-81 Meacham Road	Residential	Construction Easement
99-119 Dover Street	Commercial	Construction Easement
6 Elm Court	Residential	Construction Easement
413 Highland Avenue	Commercial	Construction Easement

Construction Considerations

The tunnels between Porter and Davis Squares would be deep bore tunnels, and would be constructed by a tunnel boring machine or conventional methods under rock cover. The rock cover extends from Porter Square Station to the vicinity of Highland Avenue where a "mixed face" - clay, till and rock - would be encountered just south of the proposed Davis Square Station. Additional soils and rock exploration will be undertaken to determine the extent of the "mixed face" condition and appropriate tunneling technique to use.

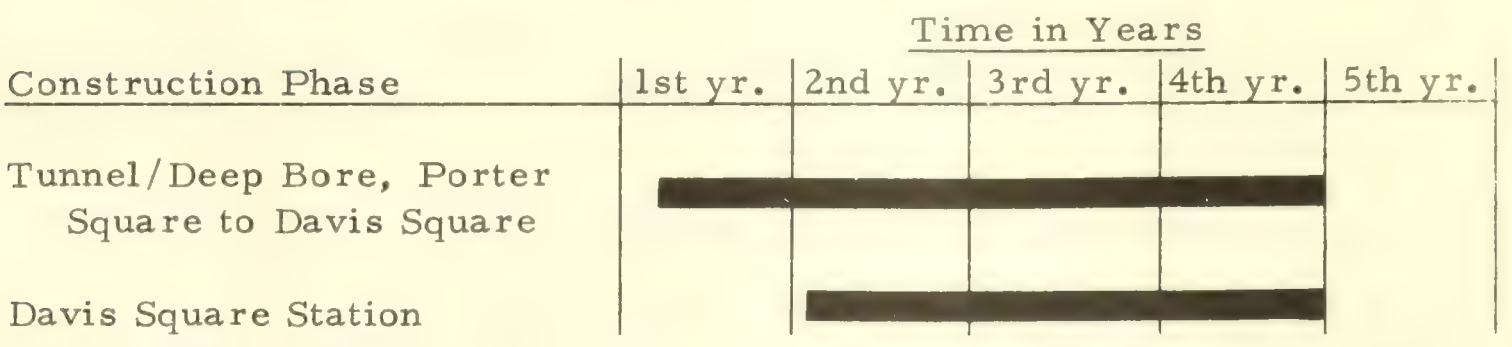
Construction of the Davis Square Station would be by the cut-and-cover method. A deck would be provided so that vehicular traffic could be maintained on College and Highland Avenues and Holland Street. Underpinning of nearby buildings is not anticipated to be required.

The ground water table would be within the limits of construction for the entire alignment. Most ground water areas could be controlled by dewatering; however, recharging of ground water may be necessary. There is no evidence of a compressible stratum below the bottom of the tunnel, nor does the void ratio of the granular material indicate that dewatering would create a settlement problem. Other methods of controlling ground water such as grouting of appropriate soils and building cutoff walls would be considered during the design stages.

The following construction sequence is based on the desirability of completing the various phases of construction at approximately the same time. The cut-and-cover portion of the project at Davis Square must be sufficiently completed to the interface of the tunnel/deep bore construction to allow tunneling machines to maneuver.

Table V-2

ESTIMATED CONSTRUCTION TIME



Costs

An itemized breakdown of costs for construction of the subway between Porter Square and Davis Square as well as the Davis Square Station is presented in Table V-3. The costs do not include project wide items such as floating slabs, trackwork, ventilation, electrification, signalization, and communications. For these costs, see Chapter II. The estimate is based on midpoint of construction costs.

Table V-3

ESTIMATED CONSTRUCTION COSTS
PORTER SQUARE TO DAVIS SQUARE
(Does not include Project wide items)

Item		Cost	
(Tunnel/Deep Bore, Deep Alignment)			
MAC Code	Description	Amount	
15.13.20	Tunnel Structure	$34,795,000	
15.13.10.12	Utility Relocations	246,000	
15.13.00	Protection & Repair of Existing Structures	497,000	
15.10.00	Demolition	55,000	
			$35,593,000

Table V-3 (continued)

MAC Code	Description	Amount		
15.06.10	Right-of-Way	$ 2,129,000		
			$ 2,129,000	
15.08.01	Professional Services	1,780,000		
15.15.02	Field Inspection	1,100,000		
15.15.02	Force Account	356,000		
15.16.00	Project Administration	2,243,000		
			5,479,000	
	Subtotal			$43,201,000
32.00.00	Contingencies			3,560,000
	Total			$46,761,000
Davis Square Station (Cut-and-Cover)				
15.11.10	Station Structure	$19,546,000		
15.13.10.12	Utility Relocation	1,316,000		
15.13.10.11	Remove & Relocate RR Track	215,000		
15.10.00	Demolition	100,000		
			$ 21,177,000	
15.06.10	Right-of-Way	363,000		
31.00.00	Relocation	250,000		
			613,000	
15.08.01	Professional Services	1,482,000		
15.15.02	Field Inspection	656,000		
15.15.02	Force Account	212,000		
15.16.00	Project Administration	1,330,000		
			3,680,000	
	Subtotal			$25,470,000
32.00.00	Contingencies			2,118,000
	Total			$27,588,000
	Total Cost for Section			$74,349,000

ALTERNATIVES

Line Segment Alternatives

The BTPR Study considered two alternative alignments in Somerville - alignments 3A and 3B. Under the 3A alignment, the Red Line Extension would continue from Porter Square under residential areas to the vicinity of Elm and Beech Streets and under Elm Street to a station at Cutter Square (BTPR Location A). The route would then continue under Elm Street to Davis Square where it would turn west along the Freight Cutoff.

The 3A alignment would have several advantages. It would utilize all available public right-of-way within the constraints of the transit criteria and the proposed station location. In addition, the 3A alignment would cross under ten less buildings and would be about 300 feet shorter than the selected alignment.

However, the 3A alignment would also have several disadvantages. Construction of this alignment would cause major disruption of Elm Street and require the relocation of several utilities. The construction would have to take place within a narrow street. Bus access to Davis Square would be easier and less congestive than to Cutter Square. Cutter Square would be close to Porter Square, a situation which would result in a serious overlap in the walk-in market. In addition, the transit station at Cutter Square would not be located at a site desired by the community. The Davis Square Transportation Advisory Group reached a consensus that the Somerville station should be located at Davis Square instead of Cutter Square. Since the 3A alignment was based on a transit station at Cutter Square, it was subsequently eliminated from further consideration.

Cut-and-cover construction was suggested as a possible alternative to the tunnel/deep bore construction from Porter Square to Davis Square. However, this construction alternative was not actively considered because it would displace up to 60 residences and numerous commerical structures.

The 3B alignment closely corresponds to the alignment selected during this study.

Station Alternatives

The BTPR Study developed two locations for the Somerville Station--Cutter Square (Location A) and Davis Square (Location B). The Davis Square TAG discussed the merits and liabilities of both alternatives and cited concerns for the areas surrounding the station.

Through these discussions, it became apparent that neither location was better from the point of view of both residents and businessmen. Key concerns were the levels of property displacement and need for a location more central to existing business activities. Based on the stated desires of the TAG, a variation of the BTPR's Location B alternative was developed. This new station location was designated B.2 and was developed by shifting the location of the station further east along the Freight Cutoff right-of-way to a point under College Avenue and Holland Street. See Figure V-2. The bus loading/unloading area would be located directly on top of the station, thereby significantly reducing the number of property takings. Under this alternative, fewer businesses and no residences would be displaced. In addition, the station would be in a central location, convenient to Davis Square commercial areas.

A preliminary impact analysis was prepared to assist TAG members in evaluating the three alternative station locations. A copy of this preliminary analysis is reproduced as Figure V-5. The higher displacement estimates indicated in this table assumed the maintenance of existing freight service. Based on this preliminary impact analysis and subsequent discussions, the TAG voted to support the B.2 station location. The Ward Six Civic Association, one of the TAG member groups cited the following reasons for its support of this alternative:

- Fewer property takings resulting in less disruption.
- More central location in Davis Square.
- Screening of surrounding residential areas from views of the station and bus loading activities.

One major concern remaining after the B.2 alternative was selected was the future of the Freight Cutoff through Davis Square. Based on the additional property takings and costs required to maintain continuous freight service during construction, an absence of direct service customers along the line, the existence of an alternative freight connector route, and the lack of compatibility between continued at-grade freight service and the operations of a rapid transit station, it was recommended that the Freight Cutoff be eliminated between Alewife Brook Parkway and east of Grove Street. It is the MBTA's objective to eliminate freight service on the Cutoff before starting subway construction. However, if the rail-freight diversion is delayed, service on the Cutoff may have to be continued during at least part of the construction period.

TRAFFIC AND TRANSPORTATION

Existing Conditions

Six streets would provide access to the proposed Davis Square Station area: Elm Street from the south, Highland Avenue from the east, College Avenue from the north, Holland Street from the west, and Dover and Day Streets from the southwest. Except for Holland-Elm Street roadway which functions as a through route, these streets all terminate at Davis Square. Table V-4 shows the estimated 1975 Average Daily Traffic (ADT) and projected 1980, 1985 and 2000 ADT on these routes.

Table V-4

AVERAGE DAILY TRAFFIC *

Route	1975	1980	1985	2000
Elm Street	18,100	18,200	18,400	18,900
Highland Avenue	11,100	11,200	11,300	11,500
College Avenue	18,100	18,200	18,400	18,100
Holland Street	15,100	15,200	15,300	15,700
Dover Street	5,000	5,100	5,200	5,300
Day Street	5,000	5,100	5,200	5,300

* Source: CTPS

Congestion is created at Davis Square by the high vehicular volumes, conflicting traffic movements, and the at-grade railroad crossings at Holland Street and College Avenue. The Termination of major traffic

carriers (College Avenue and Highland Avenue) also contributes to traffic flow problems. In addition, up to the present time, there has been no signalization in the Square.

TOPICS improvements are currently being implemented that will include both channelization and traffic signals. Proposed TOPICS improvements, which include institution of one-way restrictions on Highland Avenue and Elm Street between Cutter Street and Davis Square, are expected to alleviate some of the traffic flow conflict. Under this plan, Highland Avenue would be a one-way entrance to the Square with Elm Street serving as the exit route, and Cutter Street would be a one-way northbound connection between Elm Street and Highland Avenue.

Station Boardings

It is estimated that regardless of the terminus selected for the proposed Red Line Extension, a total of 8,100 inbound boardings per day would be generated at Davis Square. Table V-5 shows estimated 1980 daily inbound boardings at the Davis Square Station by mode of access for each alternative terminus.

Table V-5

ESTIMATED 1980 DAILY INBOUND BOARDINGS*
DAVIS SQUARE STATION

	Mode of Access				
Alternative	Walk-In	Bus	Kiss-and-Ride	Park-and-Ride	Total
Route 128	2,630	2,950	2,510	-	8,090
Arlington Heights	2,630	2,950	2,510	-	8,090
Alewife	2,630	2,950	2,510	-	8,090

* Source: CTPS

The residential densities in the station's service area and the lack of parking facilities at the station would combine to minimize the influence of the terminal's location on Davis Square ridership. Table V-6 shows the anticipated peak-hour auto arrivals by access route for each alternative.

Table V-6

ESTIMATED 1980 PEAK-HOUR ARRIVALS VIA AUTO *
DAVIS SQUARE STATION

Access Route (D)[1] and Alternative	Mode of Access: Park-and-Ride	Mode of Access: Kiss-and-Ride	Total
Dover St./Day St. (W)			
. Route 128	-	140	140
. Arlington Heights	-	140	140
. Alewife	-	140	140
College Avenue (N)			
. Route 128	-	120	120
. Arlington Heights	-	120	120
. Alewife	-	120	120
Highland Avenue (E)			
. Route 128	-	180	180
. Arlington Heights	-	180	180
. Alewife	-	180	180
Holland Street (W)			
. Route 128	-	105	105
. Arlington Heights	-	105	105
. Alewife	-	105	105

(1) (D) - Denotes direction from which arrival originates
(i.e., (N) = from the North)

* Source: CTPS

Table V-7 indicates the estimated number of feeder buses that will be required to satisfy the anticipated peak-hour demands for the Davis Square Station. In addition to the 1975 bus supply, the proposed 1980 minimum and maximum bus supply strategies which would modify existing bus service to accommodate the Red Line ridership demand at Davis Square are also shown.

Table V-7

ESTIMATED 1980 PEAK-HOUR FEEDER BUS REQUIREMENTS AND SUPPLY STRATEGIES *
DAVIS SQUARE STATION

Approach Direction	Requirements For Alternative Terminus			Supply Strategy		
	Arlington			1975	1980	
	Route 128	Heights	Alewife	Existing	Minimum	Maximum
North and West	23	23	23	24	24	27
South and East	5	5	5	30	22	24
Total	28	28	28	54	46	51

* Source: CTPS

With either the minimum or maximum service strategy, the current number of bus arrivals at Davis Square exceeds the expected demand for feeder bus service. The overall effect of this reorientation of the bus system should be a reduction in the total number of buses arriving at Davis Square during peak-hours.

The Davis Square Station is primarily expected to meet the transit needs of area residents, and it is not anticipated that a large numbers of riders from adjacent communities will be attracted. However, due to the location of Davis Square, some patronage could be expected from areas to the northeast.

There are no plans to provide off-street parking for transit station patrons, but it is expected that a feeder bus loading/unloading facility will be constructed on that section of the freight cutoff right-of-way which is proposed for elimination. A small kiss-and-

ride area may also be provided. Implementation of these facilities could create additional rail conflicts, further emphasizing the need to eliminate the freight operations.

Impacts

Based on estimates prepared by the CTPS, the parking demand at the proposed Davis Square Station would be approximately 1200 vehicles per day with any of the alternative Red Line termini. The lack of parking at the station is expected to divert approximately 120 vehicles/day from park-and-ride demand to either kiss-and-ride or feeder bus service. However, unless parking is restricted, many patrons may drive to the station and either park in on-street spaces or in off-street commercial lots in the station area. Both of these parking practices would generate additional traffic and limit the availability of short-term, on-street parking spaces for community residents and businesses. Other drivers, becoming discouraged by the lack of parking facilities, would not use the Red Line; they would either continue their trip by automobile or not travel at all, thus reducing the potential patronage of the proposed extension. Efforts will be made to emphasize to potential transit users the good bus service feeding the new station.

The large number of kiss-and-ride arrivals anticpated during peak-hours would cause congestion in the Square, particularly with no provisions for an off-street, kiss-and-ride area. These vehicles could overflow the available off-street loading/unloading space and limit movement on streets in the yicinity of the station. The greatest adverse effects would usually occur during the evening peak-hours when cars must stand and wait for transit passengers. The anticipated number of bus arrivals at the station would also contribute to this congestion.

Table V-8 shows daily and peak-hour net changes in traffic volumes in the vicinity of the Davis Square Station for each alternative terminus of the Red Line Extension. Estimates reflect both the relative decrease in daily and peak-hour traffic volumes with the diversion of through trips from auto to transit, and the increase in local traffic created by transit-induced trips to and from the station.

Table V-8

NET CHANGE IN TRAFFIC VOLUME AT DAVIS SQUARE

Alternative	Daily Vehicles	Peak-Hour Vehicles
Route 128	+3,000	+400
Arlington Heights	+3,500	+500
Alewife	+4,300	+600

During construction of the station, traffic would probably be slowed on all the approach streets, including Holland Street and College Avenue, but not to an extent that would require detours.

Mitigating Measures

A few relatively simple measures could be instituted to prohibit transit riders from using either the available on-street parking spaces or the off-street commercial parking facilities. In both areas, the installation of short-term parking meters in conjunction with a tow-away service contract should effectively control violations. In addition, commercial parking lots, such as the area east of Grove Street along the Freight Cutoff, could be modified for automatic entrances and exits, activated by the use of tokens or manually controlled gateways. A time stamp system could also be instituted. Parking restrictions should be prominently posted and the limits rigidly enforced. A proposed resident sticker program in Somerville and the ability of Community Affairs and Marketing to promote bus usage would drastically reduce parking impacts on the area.

It is anticipated that a large number of passengers will walk to the station. These passengers will have a choice of entering or leaving the station at either the east or west sides of the square, and thus many could avoid crossing the Holland Street/College Avenue confluence. The station's mezzanine concourse connecting both entrances would enable both passengers and non-passengers to traverse the north side of the square in a protected environment. The 350-foot separation between access points would also tend to disperse the pick-up and discharge of kiss-ride passengers.

It is possible that with short term meters and strict parking enforcement the proposed parking area on the right-of-way west of College Avenue could accommodate some of the kiss-ride parking needs. If used during the day as a high-turnover "shoppers" parking area, it is probable that local demand would peak-out in advance of the 4 P.M. to 6 P.M. kiss-ride demand, thus affording a limited supply of spaces.

Investigation of possible additional sites for kiss-ride and local business parking will continue in the pre-grant engineering phase.

The proposed off-street bus loading/unloading zone should curtail any congestion in Davis Square that might result from bus arrivals. To facilitate traffic flow and minimize turning conflicts, southbound feeder buses would be routed along Elm Street. They would enter the station area via Grove Street and discharge passengers on the platform above the station.

LAND USE

Existing Conditions

Plans

Development in the City of Somerville is guided by the 1969 Comprehensive Plan of Development under which general community goals, guidelines and specific neighborhood improvements were established. At present there is no comprehensive development plan for the Cambridge portion of the tunnel alignment.

Policies

Somerville has actively supported the Red Line Extension to Davis Square since it became a viable option during the BTPR Study. Mayor S. Lester Ralph officially supported the proposed extension on January 23, 1974.

The resolution on the Red Line Extension passed by the Cambridge City Council included the following recommendations for the Porter Square-Davis Square section:

- The extension should follow the BTPR alignment (via Davis Square, with a station south of Porter Square) from Harvard Square to Alewife.

- If this alignment is unacceptable to the City of Somerville, the State or the Federal government, the BTPR's Garden Street alignment (described in Chapter IX) should be substituted.

Zoning

Most of the land in the Porter Square-Davis Square section, including the proposed station area, is subject to Somerville's zoning regulations; a small portion of land at the southern end of the section is subject to Cambridge zoning laws.

Proceeding north from the Porter Square Station, the subway would pass under Business B-B and Residential B zones in Cambridge. In Somerville, the tunnel passes under Residential RA, RB and RC and Business BA and BB zones.

Land use in the vicinity of the proposed Davis Square Station is of major importance. Figure V-2 illustrates the proposed station development scheme for Davis Square. Existing zoning districts in the Davis Square area have a special height limitation provision. A Height Limitation Overlay District (HL District) created in 1974 places a maximum height of four stories or 50 feet on all existing land use zones in the Davis Square area. A portion of that district is shown in Figure V-1. The HL District was developed in response to citizen concerns regarding the desirability of high-rise development in Davis Square and has been effective in limiting such development.

Those Somerville and Cambridge land use zones found in the Davis Square Station area are identified in Figure V-1.

Current Land Uses

Since 1945, most of the construction in the Somerville area has involved the replacement of older structures with new structures. New construction has not substantially changed the land use patterns in existence at that time. Current zoning in Somerville and adjacent North Cambridge closely reflects the pattern of existing land use activities in the Davis Square Station area.

Approximately half of the length of the tunnel from Porter Square to Davis Square passes under private residential properties. The remaining portions of the tunnel pass under a mixture of commercial, multi-unit residential and manufacturing land uses. Figure II-1 B and C illustrates the alignment for this section of the proposed Red Line Extension.

The tunnel would begin under the Porter Square Shopping Center, passing under the shopping center structures and then through a portion of the Orchard Street neighborhood in North Cambridge. Entering the Ward Six area of Somerville, just west of the Spring Hill and Ward Two Neighborhoods, the tunnel would then join the proposed Davis Square Station within the Davis Square business area.

The Davis Square area has the highest residential density in Somerville--approximately 29 units per net residential acre compared with the city average of 18.9. Residential uses account for approximately 49 percent of the land in the Davis Square area; commercial uses comprise 16 percent, the second highest usage. Little vacant land is available for new commercial or residential development.

The commercial area contains approximately 750 parking spaces; about 300 of these are metered on-street spaces and the remainder are in off-street parking areas, both metered and unmetered. Figure V-1 illustrates the three main public off-street parking areas in the Square; these furnish a total of 135 spaces. Several private off-street lots provide over 300 spaces for employees and customers.

Development Trends

Over the past two decades, Davis Square has been declining as a regional commercial area, as evidenced by the loss of key tenants and reduced retail sales. The lack of parking and available land for development as well as the increased use of automobiles for shopping have combined to accelerate this decline. Changes in shopping patterns have helped to decentralize economic activity in the Square. Several key businesses have relocated including W. T. Grant, Stop & Shop, the Bargain Center--which was not rebuilt after being destroyed by fire--and F. W. Woolworth.

Davis Square currently serves neighborhood-oriented retail activities including several banks and savings and loan associations, insurance companies, real estate agencies, small retail and convenience goods stores, and professional offices. However, the Square remains the City's major business center. The total number of residential structures in the area has remained stable but, according to the U. S. Census, the number of new dwelling units within those structures increased between 1960 and 1970. The increased number of new dwelling units is possibly due to the conversion of larger residences into smaller apartments for students, young adults, and senior citizens.

The proposed Galleria development and the 59 Day Street office/commercial complex represent the current development in the area.

Impacts

Property Takings

Construction of this section of the project would displace three Somerville business properties and two business operations. These are illustrated in Figure V-2. The business operations that would be displaced are:

- Pine Tree Diner, Holland Street at the Freight Cutoff
- La Pinata Restaurant, 46 Davis Square

The railroad's control tower located in the Square would also be displaced and the Middlesex Federal Savings and Loan Association Annex, 1 College Avenue, would be partially displaced.

The 1975 assessed valuation of these properties totaled approximately $34,550. Their displacement would result in an annual loss of approximately $6,786 in tax revenues to the City. Increases in assessed valuation and tax revenues for potential development resulting from station operations and the potential revitalization of Davis Square could probably offset this loss in the future.

The 40-space public parking lot between College Avenue and Grove Street would also be displaced to permit construction of the station and the bus loading/unloading area. A smaller parking area along the Freight Cutoff between Holland Street and College Avenue would also be displaced.

Freight Cutoff

Elimination of the freight service from Alewife Brook Parkway to east of Grove Street would have a minimal effect on those industries along the right-of-way east of Massachusetts Avenue. Presently, all establishments on that line are served by team track service, i.e., shipments are not made directly to the customer, but are received at a common loading area or team track and then transferred to a truck for transport to users.

Elimination of through freight service and the connector function of the Freight Cutoff necessitates the providing of an equivalent clearance on the New Hampshire Division Railroad. A description of the area's freight operations is contained in Chapter VI and Chapter II.

If service is continued along the Freight Cutoff, both the construction cost and the total amount of displacement would increase significantly, particularly along the Davis Square to Alewife segment (Chapter VI). Along this line, a portion of the Kolokithas Upholstery Company, 407 Highland Avenue, would be displaced. In addition, all private parking areas behind those businesses on the north side of Highland Avenue would be displaced and access to the drive-in bank could be hampered.

Easements

Utilization of tunnel/deep bore techniques for construction of the subway tunnel would require the purchase of permanent easements from the affected property owners. Negotiations would be initiated with the owners of those properties identified in Table V-1. The required easement would be approximately 70 feet wide and would require that the MBTA review and approve any future major construction planned on that land. This limitation would not affect existing structures and is necessary to avoid damage to the tunnel structures; for the majority of commercial and residential properties affected, this limitation would not have any adverse impact.

Line Segment Construction

Construction of combination ventilation and emergency exit shafts would be required. Construction of these shafts would be from the surface downward and would require approximately four to six months. Temporary impacts that might result from this construction include some local traffic congestion, mud and construction equipment noise.

Upon completion of the shaft construction, gratings would be placed over the finished shaft.

Station Construction

Installation of a deck or bridge over the station construction area could result in temporary traffic congestion due to the narrowing of College Avenue and Holland Street. The deck would allow traffic to flow across the construction site while the station is being constructed below.

Construction of the station would temporarily displace the Middlesex Federal Savings and Loan Association Annex on College Avenue, requiring reorganization, expansion and redesign of the customer service areas. The proposed Highland Avenue entrance to the station could be incorporated into these plans.

The proximity of construction activities to the Waldron Realtors, Franklin Paul Clothing Store, Wilson Realty and the residential apartments above these establishments could make access to them difficult during station construction.

Activities associated with construction of the station would require a significant amount of truck traffic, e.g., for the removal of excavated material, delivery of concrete and station equipment. Removal of excavated materials would necessitate frequent trips by heavy dump trucks and concrete trucks. A significant increase in heavy truck traffic could adversely affect business and residential activities adjacent to the truck routes.

Commercial Activities

Savings in time and cost and direct access to the MBTA express service would be beneficial for both residents and businesses. Retail activities in the station area could benefit from the significantly increased numbers of people utilizing the Red Line Extension at Davis Square. The estimated 8,090 total daily boardings would provide a unique opportunity for businesses to increase sales. Temporary visual disruption of retail displays during construction is expected to be minimal. Some short-term effect on existing sales levels could be experienced by those businesses directly abutting the construction area, but no significant or long-term adverse effects are expected for the majority of Davis Square businesses.

Induced Development

The potential for residential development is limited by the scarcity of land. The downward rezoning of two adjacent neighborhoods along Dover Street and College Avenue--an action designed to limit large residential development--has the strong support of area residents. The conversion of larger residential units to smaller dwelling units is expected to continue. This rezoning, together with the HL District provisions, is expected to significantly reduce, if not prohibit, future high-rise residential or business developments in the station area. Medium-rise, medium-density residential development could possibly occur in the RC, BB and BA zones within the limitations of the HL District. It is unlikely that high-rise residential development would occur outside the HL District if attractive space continues to be available in the vicinity of other stations along the Red Line Extension. Potential high-rise office development would also be effectively controlled by the HL District.

New commuter-oriented convenience and retail businesses could be expected to develop along the major pedestrian access routes leading to the station. Increased sales for existing and new businesses could also stimulate significant improvements in the Square's physical appearance. Holland Street would be a likely location for early revitalization due to the low property valuations, older buildings, and several poorly maintained structures. These properties could easily be assembled into a larger tract of land that would be adjacent to the proposed Holland Street entrance. This potential revitalization area is illustrated in Figure V-2.

Joint Development

Opportunity for joint development could result from the proposed Davis Square Station. There are many possibilities for utilizing those lands regained following elimination of the Freight Cutoff, including park, recreational, parking or other public or private uses. Within Somerville, the majority of this land lies west of Davis Square (to the City line) and extends at least to Grove Street on the east--a combined distance of approximately 2,100 feet in a strip approximately 80 feet wide.

Urban Design

When completed, the Davis Square Station would significantly improve the physical appearance of the north side of the Square. Elimination of the Freight Cutoff, including the tracks, control tower and crossing gates, would be a major factor in improving the appearance of the Square and in encouraging further improvements by nearby property owners. The small landscaped areas in the center of the Square and west of Holland Street could serve as attractive focal points for the business area. See Figure V-3.

The proposed bus loading/unloading area would be screened from view by existing commercial developments along Highland and College Avenues. At the same time, these areas would be screened from the residential areas north along Winslow Avenue.

Mitigating Measures

Property Takings

The MBTA would compensate for properties acquired by retaining two independent assessors to appraise the fair market value of each property and structure to be taken, and by providing compensation for breaking long-term leases.

Affected property owners would still have the right to appeal the established level of compensation. Receipt of compensation would not prejudice the owners right to litigate for an adjustment in that level.

MBTA procedures are in compliance with the Federal Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 and Chapter 79A of the General Laws of Massachusetts.

MBTA staff would assist businesses in relocating by:

- Giving businesses a minimum of four months notice before being required to vacate.

- Providing advisory services to the project area if economic injury results from project activities. These services would include, but not be limited to, consultation; providing information on current relocation policies or relocation sites, zoning, and economic matters; developing small business administration programs to provide managerial and technical assistance; and establishing an office in the project area.

- Making relocation payments such as for actual moving expenses; direct loss of property; payment in lieu of moving and related expenses; expenses incurred in searching for a new location; storage costs; and property loss compensation.

A new parking area would be provided west of Holland Street, above the subway, to replace the two parking areas (approximately 50 spaces) displaced by the project. The location of this replacement parking is illustrated in Figure V-3.

With the Freight Cutoff service discontinued, a portion or all of the Middlesex Federal Savings and Loan Association Annex could be rebuilt. This would be determined during final engineering and design. The cost of redesigning the customer services area and developing an acceptable Holland Street entrance could be compensated for as a part of the project.

The potential impact on other Highland Avenue businesses is contingent upon how extensively the space behind those properties is used and transformed by construction requirements. During later design phases, the presently tenuous issues such as timing of Freight Cutoff discontinuance, and the tunneling method to be used at this location, will be clarified. Probable impacts, mitigating measures and necessary compensatory actions (if required) would then be identified and presented for review by concerned parties in the Community.

Easements

Subterranean easements would be required for those properties under which the tunnel and station would pass. Suitable compensation would be provided through negotiations between the individual property owners and the MBTA.

Construction Activities

Temporary construction impacts such as dust, noise and truck traffic could be minimized by:

- Restricting construction-related truck traffic such as the removal of excavated material to a private, temporary truck road which would be constructed along the Freight Cutoff towards Massachusetts Avenue and Route 2.

- Limiting the type of construction noise permitted during daylight and evening hours.

- Performing maintenance on construction equipment and on noise and emissions control devices.

- Washing down the construction area and approach roads to reduce dust.

- Returning the site to its original appearance or improving it with additional landscaping upon completion of the project.

Potential disruption of traffic on Holland Street and College Avenue could be minimized by adding a deck or bridge across the construction area to permit uninterrupted flow of traffic. Installation of the deck during evening hours and on weekends could further reduce this disruption.

Induced and Joint Development

The land use subcommittee of the Davis Square TAG is examining alternative strategies for directing future improvements in the Davis Square area. Key issues to be resolved include: the best use for land regained by eliminating the Freight

Cutoff; appropriate types of future commercial development for a revitalized Davis Square; and meeting area parking needs. This committee would serve as the advisory group during land use studies being funded by the Federal government after the station is approved. Approximately $50,000 would be provided through the MAPC for these studies.

NEIGHBORHOOD AND COMMUNITY FACTORS

Consideration of the project's short- and long-term effects on the quality of life in adjacent neighborhoods has been a major factor in evaluating the proposed Red Line Extension. The Davis Square TAG, representing area neighborhoods and business groups, has provided local guidance and advice for the Porter Square-Davis Square Section.

Existing Conditions

This section of the proposed Red Line Extension passes through several neighborhood areas as defined by the Somerville Planning Department including Davis Square, Spring Hill, Powderhouse, Tufts and West Somerville.

Neighborhoods

The Davis Square Neighborhood, site of the proposed station, is bounded generally by Morrison and Park Avenues on the north, Grove and Cutter Streets on the east, Russell Street and the City boundary on the south and the Freight Cutoff and Thorndike Street on the west. Principal land use activities include the commercial-business district adjacent to the Square and the surrounding residential areas. The neighborhood consists predominantly of two-, three- and four-story apartment buildings with some small residential buildings on large lots. The Davis Square Neighborhood would experience the most direct effects of this section of the Red Line Extension.

The Davis Square Neighborhood is located on the northwest side of Ward Six. In addition to being a political unit, Ward Six encompasses the major organized resident group in the Davis Square area--the Ward Six Civic Association. This group represents parts of the five neighborhoods in the vicinity of Davis Square.

Spring Hill Neighborhood is bounded on the west and south by Somerville Avenue and the City boundary, and on the east by School Street and Highland Avenue. The Powderhouse Neighborhood, east of Spring Hill, is bounded by Highland Avenue, Benton Street, the MBTA's Southern Division Line, Broadway Avenue and College Avenue. The Tufts Neighborhood is bounded on the south by College Avenue, on the east by the City boundary, and on the north and west by Winthrop Street and Holland Street, respectively. The West Somerville Neighborhood encompasses the portion of Somerville between the Tufts Neighborhood and the western City boundary north of Thorndike Street.

Current land use issues in the Davis Square Neighborhood area include the compatibility of high-rise development with existing residential environments; the rezoning downward of existing land use districts to reflect the existing residential environment; and the hazards and noise associated with the Freight Cutoff.

Between 1960 and 1970, the population of the Davis Square Neighborhood declined 5.8 percent to 2,054. There are few households or families with people between 30 and 50 years old. While 12 percent of the City's population is over 65 years of age, approximately 24 percent of those in the Davis Square Neighborhood are over 65 years of age. The neighborhood's proximity to several major universities has attracted a large number of students, and young adults. A large part of the student and elderly population is concentrated in the area south of Elm Street and north of the City limits. Approximately 39 percent of the total households in the neighborhood (334) are single-person households.

Available data from 1960 indicate these populations for the other four neighborhoods: Spring Hill, 13,059; Powderhouse, 12,609; Tufts, 6,609; and West Somerville, 10,398. In June 1970, the combined population for those areas within a one-half mile walk from the proposed station was approximately 20,221; of these, approximately 5,523 (27 percent) were below 18 years of age. Persons over 65 accounted for 18 percent (3,579 persons) of that total.

The Davis Square Neighborhood contains 867 housing units; 72 percent are renter-occupied as compared with the City average of 66 percent. The median rent of $107 per month in 1970 was higher than the City average of $97, but lower than the Boston SMSA average of $133. In 1966, the net residential density

for the Davis Square Neighborhood was estimated to be approximately 29.9 units per acre--the highest in Somerville.

Total housing units and net residential densities for the other four neighborhoods are given below:

Neighborhood	Total Housing Units	Residential Density
Spring Hill	882	24.3
Powderhouse	3,748	23.6
Tufts	3,748	22.3
West Somerville	1,789	22.7

In 1972, the combined housing for those areas within a one-half mile walk of the proposed station totaled 6,895 dwelling units; 2,454 (35.5 percent) of these were owner-occupied units with a median value of $19,900. Renter-occupied units comprised 62.6 percent (4,319) of the total, with average rents of approximately $107.

The Somerville Planning Department, using 1970 census data, has estimated that 12 percent of the renter-occupied households in the Davis Square Neighborhood earn less than $5,000 a year and pay approximately 35 percent of their income for rent. Many of these households are receiving rental assistance. In 1969, the median income for Somerville was $9,595, which is approximately 16 percent lower than that of the Boston SMSA.

Residential parking in the neighborhood is limited due to high parking demand and close proximity to the Davis Square commercial activities. A resident parking sticker program, similar to the one in Cambridge, is presently being considered for Somerville.

The number of crimes against persons has been increasing around the Square, due in part to the lack of activity and people in the Square during the evening hours.

Pedestrian Circulation

The high residential densities close to the Davis Square commercial area have made people highly dependent on walking for retail and other shopping trips. Pedestrian activity related to work

trips--walking to work or to the bus--is equally significant. Table V-9 summarizes the transportation modes utilized for work trips in 1970.

Table V-9

MODE OF TRANSPORTATION TO WORK
(Percent)

	Walking	Automobile	Public Transport
Davis Square Area	10.0	58.6	30.0
City of Somerville	9.5	55.5	32.7

Pedestrian-vehicular conflicts occur on major streets in the area and at the Freight Cutoff at-grade crossing. The most severe pedestrian-vehicular conflicts occur in the Square where six streets meet. Davis Square has been ranked as the eighth major accident location in Somerville, based on the intensity of accidents occurring between 1961 and 1965 (as discussed in Somerville's Comprehensive Plan). The implementation of TOPICS improvements is expected to significantly improve this situation.

Community Facilities

Residents of Davis Square area neighborhoods have access to a variety of community facilities. In the vicinity of the station, there are two recreation areas-Kenney Playground and Hodgkins Playground. Kenney Playground is located at the corner of Highland Avenue and Grove Street.

A branch of the Somerville Public Library is located on College Avenue near Morrison Avenue. Hodgkins, Brown and Kennedy Elementary Schools and Western Junior High School serve the Davis Square neighborhood.

Impacts

Neighborhoods

No direct long- or short-term physical changes are expected for the neighborhoods in the Davis Square area as a result of the project. A short-term alteration in the physical appearance of the Davis Square commercial area could be expected.

The Davis Square Station could have a positive effect by encouraging revitalization of the business-commercial area. Both the residential and business communities are working toward successful revitalization through the efforts of the Davis Square Task Force. As previously mentioned, potential future high-density residential development would be limited by vertical height restrictions and residential density limitations.

Although no parking would be provided for park-and-ride commuters, some people would attempt to park in the vicinity of the station, utilizing existing residential or commercial parking areas. This increased demand for the limited space could adversely impact both the residential and business communities if parking restrictions were not instituted. In addition, instead of staying on the major streets, kiss-and-ride vehicles may be tempted to take a short cut to the station by going up Grove Street and back to College Avenue on Winslow Avenue. This route passes through a residential area and could also have a negative impact.

Construction of the proposed station would contribute to improving public safety in Davis Square in the following ways:

- Additional numbers of persons boarding the Red Line Extension at Davis Square each day could reduce crime by making the area less deserted.

- New and improved commercial activities resulting from increased retail sales could encourage more frequent use of the Square during evening hours.

- Construction of the bus loading/unloading area would afford a well-lighted central location for boarding buses during evening hours.

Security considerations have been incorporated in the station design which features a column-free interior with minimum length entrance tunnels, to permit a clear view of the platform area and tunnels from the mezzanine.

Pedestrian Circulation

Removal of the Freight Cutoff would help eliminate several existing pedestrian-rail and vehicular-rail conflicts in the Somerville area. If Freight Cutoff service is maintained, existing conflict points would be further affected by the increased number of boarders nearby. The arrival of feeder buses in the general station area would increase these negative effects.

Employment

Relocation of the Davis Square businesses (described in the Land Use Section) could have varying effects on current employees. There would be little or no adverse impact for employees of those businesses relocating in Davis Square. Relocations outside of Davis Square could adversely affect employees by requiring more travel time to get to work. If the businesses do not choose to relocate or cease operations, a loss of jobs would result.

Community Facilities

The station would provide improved access from Davis Square to other community facilities such as those in the Alewife area or in Boston. No disruption of community facility service areas is expected since the alignment would be constructed below the surface.

Mitigating Measures

The anticipated park-and-ride parking demand in residential areas adjacent to Davis Square could be significantly reduced with the adoption and enforcement of a resident parking sticker program.

To discourage the use of North Grove Street and Winslow Avenue as a short cut for kiss-and-ride vehicles, some form of temporary or permanent barrier could be provided.

Placement of entrances at two separate locations illustrated would reduce pedestrian-vehicular conflicts by providing access to the station from opposite sides of the Square. Direct entrances to the station adjacent to the bus loading/unloading area would permit a majority of riders to transfer to buses without crossing major area streets. The recently installed traffic control system should enable pedestrians to cross the various intersections under controlled, safe conditions.

HISTORIC RESOURCES

Existing Conditions

Four buildings of historic significance have been identified in the immediate vicinity of the proposed alignment within this section. In a survey prepared by the Cambridge Historical Commission, the historic resources were classified into categories according to their relative architectural and social value. These categories are:

> Primary Importance: Generally those structures of outstanding value. They are considered worthy of nomination or are already listed in the National Register of Historic Places;
>
> Very Important: Structures of slightly less significance and age;
>
> Important and Moderately Important: Buildings of local significance but not currently under consideration for submission to the National Register.

Determinations were based on architectural integrity, as well as the significance, incidence, or scarcity of structures of a particular style, or period, or designed by a specific architect.

The historic resources within the zone of potential influence of one or more of the transit alternatives between Porter Square and Davis Square include:

1. 51 Davenport Street. This structure, built in 1858, has been classified as Moderately Important. It is a good example of cupolaed Italianate design, and is necessary to maintain the suburban scale of the area in which it is located.

2. 140 Elm Street. This structure, built in 1860, is located on the south side of Elm Street near Beech Street. It is a good example of Mansard Style. It has been classified Moderately Important and is necessary to the suburban scale of the street.

3. Somerset Savings Bank, Cutter Square. This building, completed in 1930, is an excellent example of Early Art Deco and has good bronze details and siting. Its setback and towered form makes it a landmark for Cutter Square, and it has been classified Important.

4. Hobbs Building and Somerville Theatre, Davis Square. Completed around 1915, the movie theatre is in the Neo-Classical Style. The auditorium has retained the theatre's original form and details. The complex has been classified Moderately Important.

Impacts

No taking or destruction of historic resources is anticipated due to the use of tunnel/deep bore construction well below the existing land surface. During station construction, the use of the Hobbs Building and Theatre may be disrupted, but the actual construction would be adjacent to the building. No long-term impacts on historic resources are anticipated. Ventilation and relief shafts would be located several hundred feet away from the historic buildings and no related impacts are expected.

It is possible that the historic buildings would experience settling and other structural impacts resulting from the vibration of foundations during tunnel construction. Noise and dust resulting from the construction could also have a temporary negative esthetic impact on these structures. In the station area, where cut-and-cover construction would be utilized, use of the Hobbs Building may be further disrupted, but it would be returned to normal following completion of the project.

Mitigating Measures

All historic structures will be closely monitored during the construction process and will be examined periodically following completion of the project. In the event that damage appears, appropriate repairs would be made in accordance with the authentic character of the structure. Ongoing coordination with Cambridge and Somerville Historical Commissions would be maintained throughout the construction process to assure an absolute minimum of disruption.

NOISE AND VIBRATION

From Porter Square to Davis Square, the alignment would pass beneath several homes in a tunnel/deep bore. Outdoor noise level measurements would provide little usable information for noise assessments since ground vibration is more important in these areas. Specifically, rumbling noise from transit operations at night may create intrusion on sleeping quarters in these homes. Ambient noise levels at night in these residences are estimated to range from 40-45dBA based on estimates in Appendix "D" for "Average Urban Residential" areas.

Existing noise levels in the vicinity of Davis Square were documented. Measurements using the BBN 24-hour monitoring system are shown in Figure V-6. Noise levels are relatively constant during the daytime and gradually fall off about 10 dBA at night. Trains passing through the area show up as hourly peaks in the data. Short-term measurements tend to corroborate the high midday noise levels in this area due to high traffic density. The measurements are summarized in Table VIII-10.

Table VIII-10

SHORT-TERM NOISE MEASUREMENTS AT DAVIS SQUARE

Site No.	Location	Time	Levels (dBA) L_{eq}	L_{10}	L_{50}	L_{90}
18	10 Cottage Street, Somerville	14:10	52	53	45	41
6	82 Dover Street, Somerville	11:00	60	63	51	45
7	Lester Terrace, Somerville	19:20	50	53	49	49
9	43 Grove Street Somerville	15:15	58	59	55	53

See Figures II-1A, 1B, 1C, 1D, and 1E for location of noise measurement sites.

Noise levels in some parts of this area could be classified according to Appendix "D" as "average urban residential" while other parts of the area could be classified as "busy urban residential" based on the ambient noise at night.

Impacts

Line Operations

Since the alignment between Porter Square and Davis Square would be in tunnel/deep bore, there would be no airborne noise problems resulting from transit operations. However, there may be noise from the ventilation, emergency and air relief shafts. Measurements on the existing Red Line show that untreated shafts with direct opening to subway tunnels have noise levels of 75-80dBA at 50 feet during each train passage; such noise levels are unacceptably high for all homes located within 100 to 200 feet from the shaft.

Station

Noise associated with feeder buses could increase the noise levels in residential areas. The peak hour average noise levels in the immediate vicinity of the bus routes would increase approximately 6dBA which would be a noticeable, but an acceptable increase. Referring to Figure V-6, the diurnal noise pattern in Davis Square shows an hourly average sound level during peak hours of approximately 67 dBA.

Rapid transit train noise at the Davis Square Station is not expected to be a problem for surrounding land uses.

Vibrations

Ground vibrations are expected to be similar to those anticipated for the Harvard Square Section. The prediction method described in Chapter III shows that a potential problem of audible sound from train-induced ground vibrations exists in homes within 100 feet of the centerline of the alignment between Porter Square and Davis Square. Homes directly over the alignment would be most affected because in addition to the potential problem of audible sound, there may also be a problem of perceptible vibrations. All homes within 100 feet of the centerline of each track should be also considered as having potential problems from perceptible vibrations. More detailed assessments will be carried out during the design stage. Little danger of structural damage exists from ground vibrations in this area.

Assessments

Absolute Assessments

Noise levels on the surface are not expected to be exceeded by subway operations along the segment.

Changes in Noise Levels

Existing noise levels should not be affected by train operations, although secondary induced traffic and bus operations would increase average peak hour noise levels in buildings facing the bus loading area by approximately 6dBA due to the concentration of buses in the station area.

Mitigating Measures

Vibration control should be planned in the vicinity of homes under which the subway passes. A complete discussion of applicable techniques is presented in Chapter II.

Ventilation emergency and air relief shafts should be located in the least sensitive sites and should be treated for noise reduction.

Appropriate barriers and/or landscape techniques should be utilized to mitigate increases in bus noise levels in the station area.

AIR QUALITY

Areawide air quality impacts were discussed in Chapter II, and the following discussion is restricted to localized CO effects in the vicinity of the Davis Square Station. The details of the analytical methodology and the results are presented in Chapter III of Appendix H. The analytical method considered the effects of induced traffic at the station in making air quality projections.

The predicted levels of carbon monoxide in the vicinity of the Davis Square Station in the 1974 base year, 1980 no-build case, and the three build alternatives are given in Table V-11. All 1980 cases show substantial improvements in CO levels in comparison with 1974. There are slight increases in CO concentrations for the build cases over the no-build case. Such changes are considered insignificant in view of the areawide improvement in air quality resulting from the extension.

Air quality impacts from construction activities are discussed in Chapter II.

Table V-11

PREDICTED CARBON MONOXIDE CONCENTRATIONS (PPM)
IN THE IMMEDIATE VICINITY OF THE DAVIS SQUARE STATION

Meteorological Condition	Averaging Period	1974	1980: No Build Case	1980: Build Case Termination at: Route 128	Arlington Heights	Alewife
Worst Case	8 Hours	6.6	3.2	3.4	3.4	3.5
	1 Hour	10.7	5.2	5.5	5.5	5.6
Most Probable	8 Hours	1.6	0.8	0.9	0.9	0.9
	1 Hour	2.2	1.1	1.2	1.2	1.2

CONSTRUCTION IMPACTS

The major adverse impacts of construction would be air and noise pollution, traffic disruptions, maintenance or relocating of utilities, siltation and erosion, effect on existing structures, disposal of excavated materials, spillage, effects on groundwater table and possibility of encountering an underground stream. A discussion of the general construction impacts can be found in Chapter II. The remaining portion of this section discusses specific construction impacts applicable to this segment.

Traffic Disruption

Temporary decking and construction will be necessary where the project alignment passes under College Avenue and Holland Street. It is assumed that the Fitchburg Freight Cut-off is permanently eliminated in the project area. For further discussion turn to "Construction Considerations" on page V-6; "Freight Cut-off" on page V-21; "Easements" and "Line Segment Construction" on page V-22; "Station Construction" on page V-23; and "Construction Activities" on page V-27.

Several utilities will be maintained or relocated. The City of Somerville has plans for building an 84" storm drain interceptor along the MBTA R.O.W. which must be provided for. This will have to be done as part of the relocation of the existing 48 x 52 inch existing storm drain.

Effects on Existing Structures

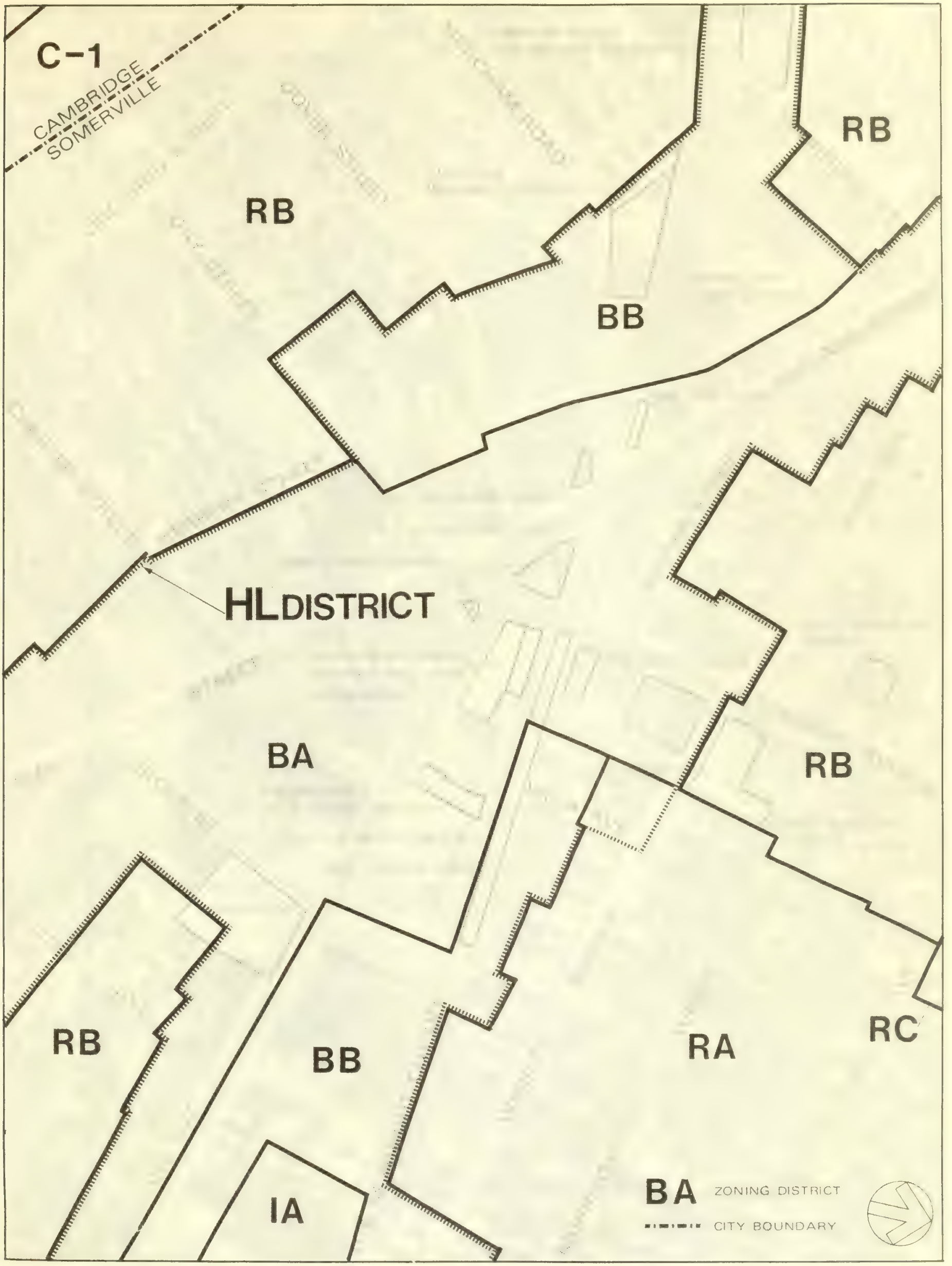
For a discussion on this issue see Construction Impacts Section in Chapter II.

Disposal of Excavated Materials

It is estimated that there is 70,000 cubic yards of excavated material in the construction of the Davis Square Station, and 71,000 cubic yards in the tunnel segment from Porter to Davis Square.

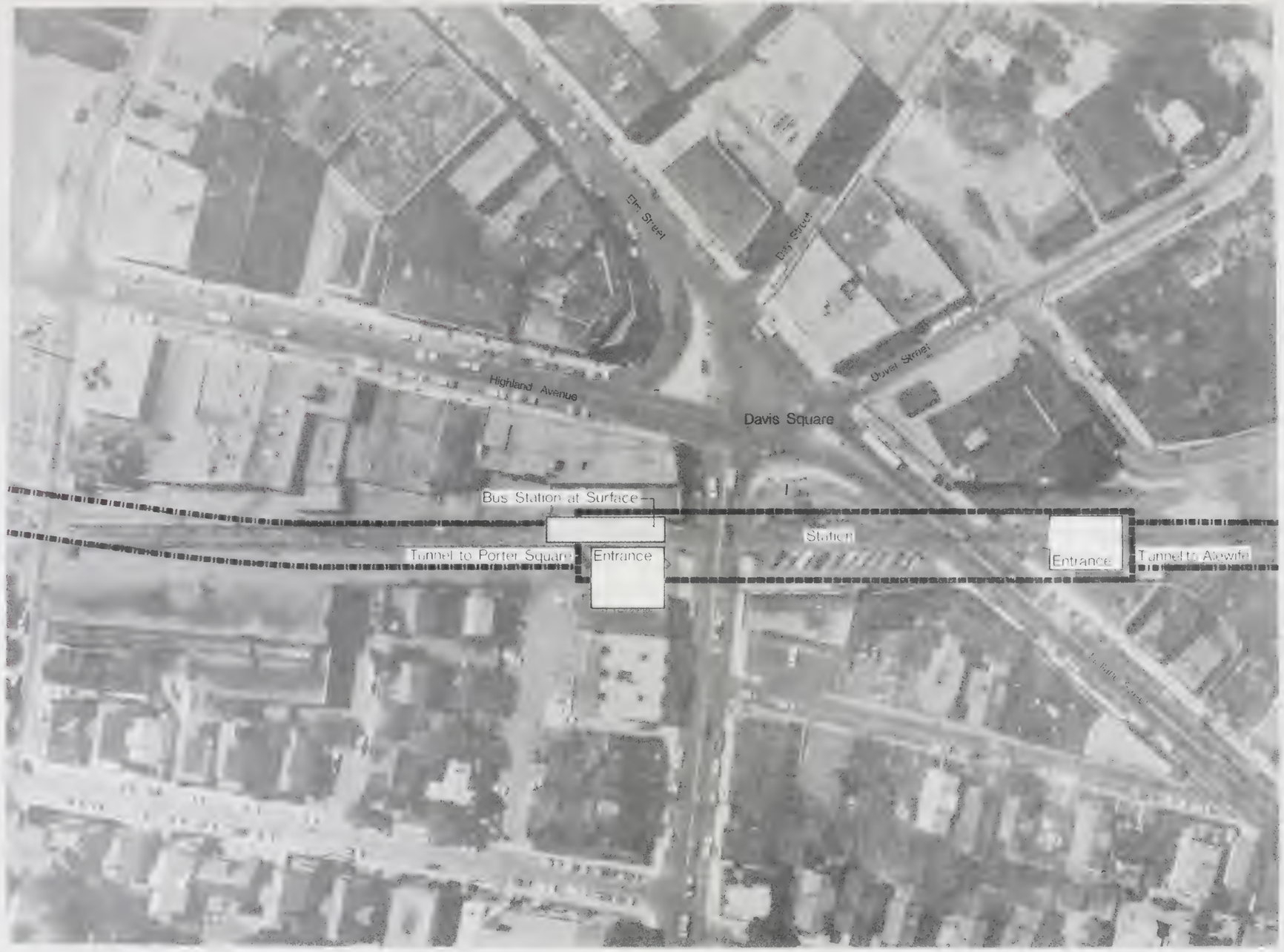
Historic Resources

No taking or destruction of historic resources is anticipated due to the use of tunnel/deep bore construction well below the existing land surface. For a discussion, turn to Pages V-35 and V-36, "Impacts" and "Mitigating Measures" (Historic Resources).



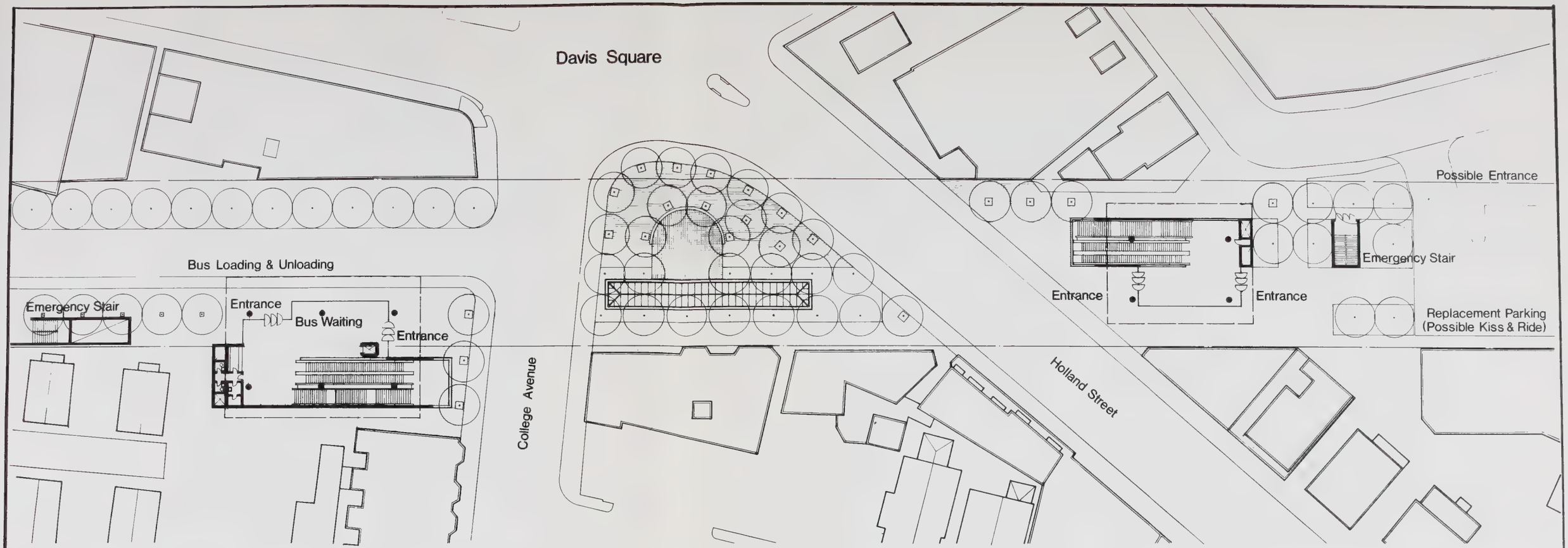
Massachusetts Bay Transportation Authority

DAVIS SQUARE
EXISTING CONDITIONS
FIG. V - 1

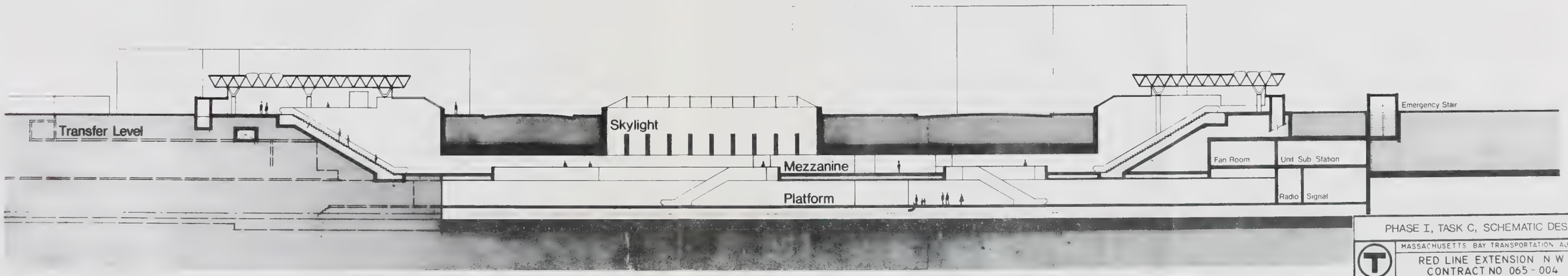


Davis Square Station

Schematic Design · Red Line Extension Northwest · Goody, Clancy & Assoc., Inc.



Ground Floor Plan



Section A·A

PHASE I, TASK C, SCHEMATIC DESIGN

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

RED LINE EXTENSION N W
CONTRACT NO 065 - 004

DAVIS SQUARE STATION
Ground Floor Plan & Section

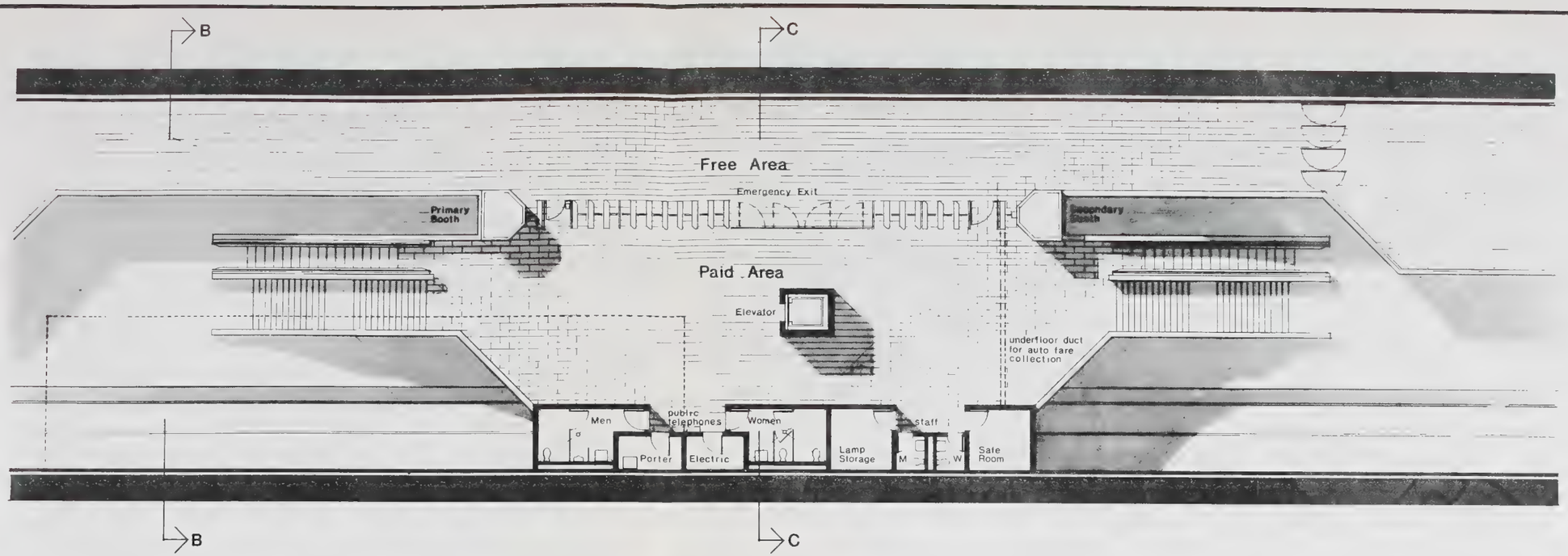
GOODY CLANCY & ASSOCIATES INC
ARCHITECTS BOSTON MASS
LEMESSURIER ASSOCIATES SC
STRUCTURAL ENGINEERS CAMBRIDGE MASS
COSENTINI ASSOCIATES INC
MECHANICAL & ELECTRICAL ENGINEERS
CAMBRIDGE MASS
HALEY & ALDRICH INC
GEOTECHNICAL ENGINEERS CAMBRIDGE MA

MASSACHUSETTS BAY
TRANSPORTATION AUTHORITY
APPROVED BY
PROJECT MANAGER

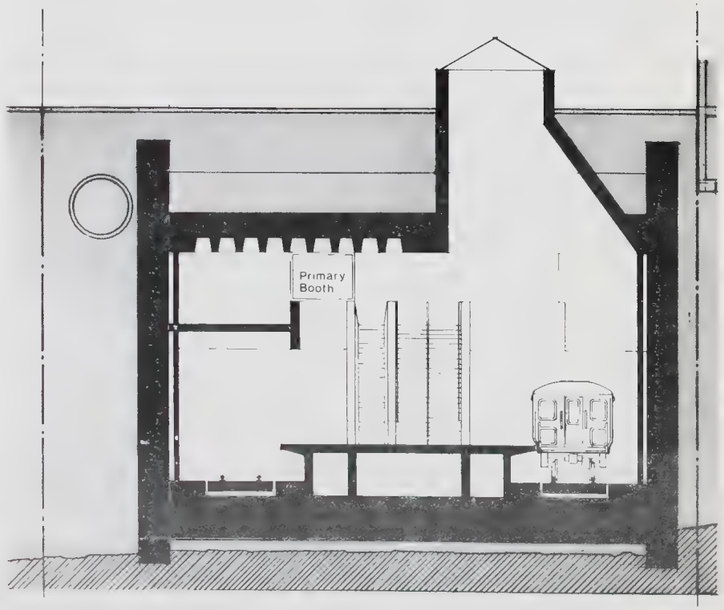
SCALE 1" = 20'
DATE 18 JAN 77
DR BY
DES BY
CHK BY
PLAN NO A-3
SHEET 4 OF 28

RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

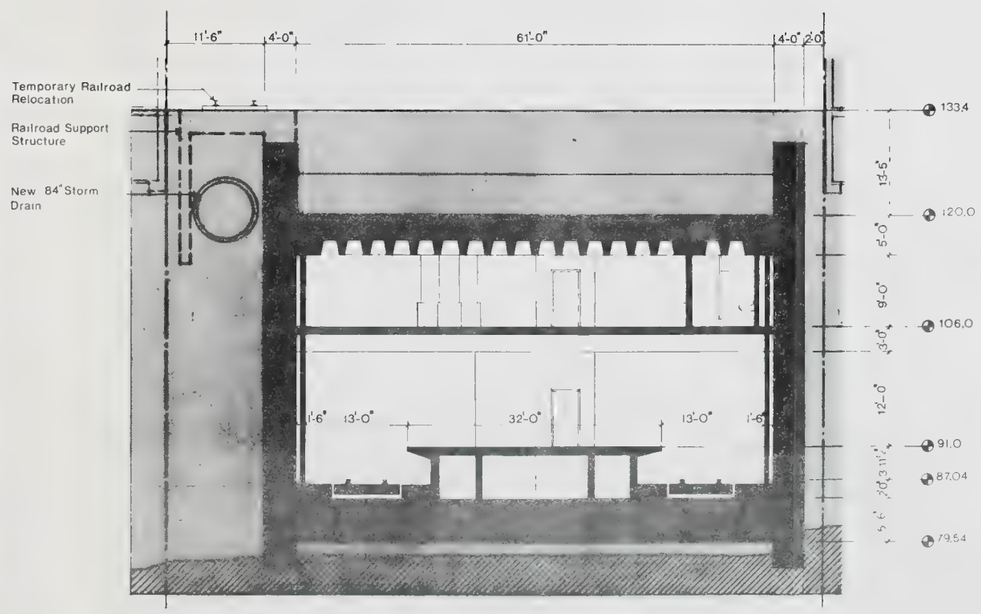
DAVIS SQUARE
GROUND FLOOR
FIG. V - 3



Mezzanine Plan



Section B-B



Section C-C

PHASE I, TASK C, SCHEMATIC DESIGN

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

RED LINE EXTENSION N W
CONTRACT NO. 065 - 004

DAVIS SQUARE STATION

Mezzanine Detail Plan & Section

CODY ANDERSON ASSOCIATES INC. ARCHITECTS, BOSTON, MASS.
LEMESSURIER ASSOCIATES INC. STRUCTURAL ENGINEERS, CAMBRIDGE, MASS.
COSENTINI ASSOCIATES INC. MECHANICAL & ELECTRICAL ENGINEERS, CAMBRIDGE, MASS.
HALEY & ALDRICH INC. GEOTECHNICAL ENGINEERS, CAMBRIDGE, MA.

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

PROJECT MANAGER

SCALE 1/8" = 1'-0" | DR. BY | DES. BY | CHK. BY | PLAN NO. A - 9 | ISSUE

DATE 18 JAN 77 | SHEET 10 OF 28

RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

DAVIS SQUARE
MEZZANINE LEVEL
FIG. V - 4

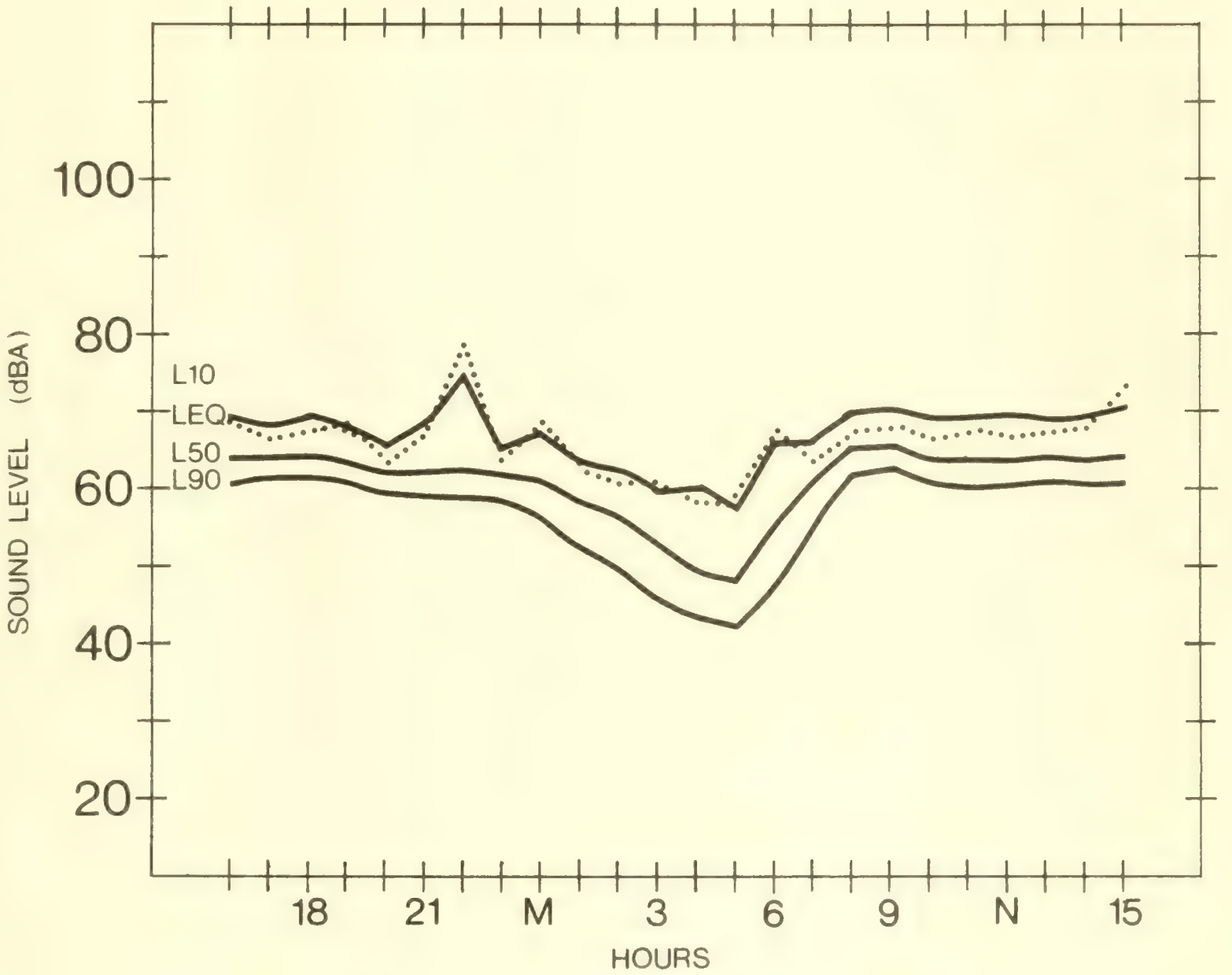
PRELIMINARY COMPARISON

OF ALTERNATIVE SUBWAY STATION LOCATIONS IN THE DAVIS SQUARE AREA

	LOCATION A	LOCATION B1	LOCATION B2
Station Ridership		Maximizes service area; could increase walk-in area by as much as forty percent. Would provide maximum service to the City of Somerville.	
Bus Loading	Low traffic volume would minimize potential traffic conflicts.	Requires some on-street bus loading. Potentially increased traffic conflicts on Holland Street.	Potentially would require on-street loading.
Kiss and Ride	Low traffic volumes would minimize potential traffic conflicts resulting from Kiss and Ride activities. Could provide off-street Kiss and Ride facilities.	Could provide off-street Kiss and Ride facilities.	Same as B-1
	Control of residential parking areas by a Resident Sticker Program would be necessary at all three station locations.	Temporarily displaced commercial parking areas would be restored after construction. Potential joint development areas could provide new parking opportunities for residential and commercial use.	Permanently relocate existing parking area (along B&M tracks) between Grove and Holland Streets, south of Holland to Dunna Vista Street. Parking adjacent to the B&M tower would be temporarily displaced. Joint development parking opportunities would be the same as B-1
	Would permanently eliminate street and off-street parking spaces in station area. Potential for new parking area development is limited.		
Feeder Bus	Lowest existing traffic would tend to minimize conflicts. Buses would continue to use Cutter Street.	Buses would continue to use Cutter Street, but less turning conflicts than B-2 would result.	Could eliminate Feeder Bus Routes on Cutter Street by use of Grove Street between Elm and Highland, but a minor modification of the TOPICS Plan would be necessary.
Pedestrian Traffic	Some Cutter Square pedestrian movement would continue toward Porter Square in existing patterns. Most Cutter Square is lost.	In the mainstream of Davis Square pedestrian traffic.	
Emergency Services	Would minimize potential traffic conflicts.	Could add to traffic conflicts in Davis Square.	Could reduce Davis Square congestion.
Grade Separation	No railroad grade separation is part of this project.	Same as A	
Traffic Signalization	Alternatives are consistent with the scheduled TOPICS Traffic Control Signal System scheduled for installation this year.	Same as A	Same as A
PARKS AND HISTORIC RESOURCES			
Open Space	Opportunity for a mini-park; total area approximately 0.10 acres.	Opportunity for lands-cape; total area approximately 1.00 acres.	Several opportunities exist for mini-parks and landscaped areas; total area approximately 0.40 acres.
Historic Sites/Buildings	No historic resources are affected.		No historic resources are affected.
ECONOMIC			
Development Costs	Not available at this time.	Not available at this time.	Not available at this time.
Relocated Property Valuation (Based on City of Somerville Assessment and Tax Records)	$792,225	$263,375	$135,475
Taxes Lost (Loss to City of Somerville 1974 Tax Rates)		$49,796	$22,683
COMMUNITY AND SOCIAL			
Pedestrian Circulation	Not as convenient for the largest number of Somerville walk-in users.	A more central location for Somerville and the traditional Davis Square business center. No station entrance is provided south of the B&M line. Boarders would be disrupted by freight train operations.	Same as B-1 but also provides an entry on both sides of the Freight Cutoff that can be used as a free pedestrian underpass during train operations.
Quality of Residential Streets	Temporary congestion as a result of construction activities along Elm Street could encourage short-cut traffic on local residential streets. Increases in new feeder bus volumes would add more buses on Cutter Street.	Feeder bus volume would increase on Cutter Street. Removal of bus loops south of Holland Street takes the station area out of the Porter Square/Davis Square bus circulation loop and could result in bus traffic on residential streets for bus circulation.	Feeder bus traffic on Cutter Street could be eliminated and relocated to Grove Street between the Freight Cutoff and Elm Street. A minor modification of the TOPICS plan for Highland and Elm Streets would be necessary to make two-way from Cutter to Grove.
ECOLOGY			
	No effect on ecological systems.	No effect on ecological systems.	No effect on ecological systems.
LAND USE			
Compatibility with Surrounding Land Uses	Directly adjacent to a mixed commercial and residential area.	Commercial, industrial and railroad uses predominate in the area with residential uses.	Same as B-1
Property Takings Note: All estimates include two dwelling units, two business and one partial business relocations that would be required regardless of alternative selected. The relocations are a result of tunnel rather than station construction.	Full Relocations Dwelling Units 2 Businesses 6 Partial Relocations Businesses 1	Full Relocations Dwelling Units 11 Businesses 19 Partial Relocations Businesses	Full Relocations Dwelling Units 4 Businesses 5 Partial Relocations Businesses 1
Effect on Retail Display	Construction activities would directly disrupt access to retail display windows for businesses adjacent to the station. Secondary impacts especially congestion resulting from construction related traffic would affect the total number of potential customers passing by all businesses on Elm Street between Davis Square and Cutter Street for the construction period.	Direct retail window display disruption can be expected for businesses on the northwest side of Davis Square. Reduced traffic disruption is not expected to have a significant effect on reducing the total number of potential customers in that area.	Same as B-1
	The proposed new park areas and station entrys could complement the Cutter Square area. This would, however, entail the cost of relocating one of the Square's newest structures, the Ming Tay Restaurant.	Displacement of buildings on both sides of Holland Street would change the appearance of this side of the square. These structures have traditionally screened residential areas along Winter Street from commercial activities in the Square.	Would result in the smallest long term change in the visual appearance of the Square, creating new open spaces.
Induced Land Uses	Pressure for new service type businesses and/or commuter oriented commercial and higher density residential developments would increase.	Possible induced commercial and higher density residential developments would be incompatible with the existing zoning and land use in the Davis Square area.	Same as B-1
Joint Development Potential	Joint development potential at the Cutter Square area is constrained due to the surrounding residential neighborhood and close proximity of the Porter Square commercial area.	Joint development opportunities are greater in the Davis Square area due to aging buildings, lower assessed valuations and vacant lots which make acquisition of larger parcels of land possible.	This alternative has the same joint development opportunities as B-1 but maximizes the development of these developments by reducing the land area required for transit facilities.
Geometrics	Centering the station at Elm Street requires several sub-standard curves with radii in the range of 1000 to 2000 feet.	Generally has a straight alignment except for one sharp curve 700 feet radius near the freight cut-off.	Same as B-1
Station Spacing	Would be the closest to the Porter Square Station approximately 2500 feet away.	Davis Square - Porter Square station spacing would be approximately 4200 feet.	Davis Square - Porter Square station spacing would be approximately 3800 feet.
Construction Easements	Lowest amount of private property to be acquired by easement.	Greater amount of private property to be acquired by easement.	Same as B-1
Cut and Cover Station Construction			Same as B-1 except the station area would require decking during construction.

RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

DAVIS SQUARE
PRELIMINARY
IMPACT ANALYSIS
FIG. V – 5



RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

DAVIS SQUARE
DIURNAL NOISE PATTERN
FIG. V - 6

Chapter VI

DAVIS SQUARE TO ALEWIFE

Chapter VI

DAVIS SQUARE TO ALEWIFE

PROJECT DESCRIPTION

The alignment from Davis Square to Alewife would extend in tunnel/cut-and-cover from Davis Square along the Freight Cutoff right-of-way, across the northwest corner of Russell Field, across the W. R. Grace property just north of Jerry's Pond and Lehigh Metal Products, beneath Alewife Brook Parkway, and on towards East Arlington and Arlington Center along the MBTA Lexington Branch Railroad right-of-way (See Figure II-IC).

The transit station at Alewife would be located beneath the Alewife Brook Parkway just north of Lehigh Metal Products. This location is a modification of the Station Location B alternative originally proposed in the BTPR report. Entrances and fare collection facilities would be located on both sides of the Parkway at the ends of the station platform which lies on an east-west axis. A parking garage for transit users, containing kiss-and-ride and bus loading/unloading facilities, would be constructed on a site west of the Parkway and north of the Rindge Avenue Extension; this site is currently occupied by Cambridge Dodge, Hayes Oil Company, Lewis E. Tracey and three or four other small businesses. A mezzanine or lobby would be constructed one level below grade and beneath the parking garage to provide access from the garage to the station platform. The platform would be located east of the garage two levels below grade. An underpass located beneath Alewife Brook Parkway will provide free pedestrian circulation between the east and west sides of the Parkway. The Alewife complex also includes a section of tunnel extending from the station across the Alewife Brook Reservation to Route 2. Turnback crossovers and a lay-up track would be provided in this tunnel section.

Construction of the Davis Square to Alewife Section, which includes the line segment between the two stations, the Alewife Station, the parking garage, and approximately 1,600' of tunnel north from the Alewife Station would cost approximately $99,279,000 and require three to four years for completion.

It is proposed to abandon the Lexington Branch Railroad. For further discussion, see Chapter II.

It is proposed that the Freight Cutoff be eliminated between east of Grove Street in Somerville and east of Alewife Brook Parkway in Cambridge. A team track for transferring rail freight in trucks would be built to serve those businesses whose rail service would be discontinued due to the elimination of this portion of the Freight Cutoff. Two possible sites for the proposed team track are:

- Along the existing Freight Cutoff right-of-way east of the proposed Davis Square Station.

- The Boston and Maine's existing West Cambridge Yard west of Alewife Brook Parkway in the "industrial triangle".

The most appropriate sites will be selected during more detailed studies in conjunction with the affected cities and the Boston and Maine Railroad.

Line Segment

From the Davis Square Station in Somerville, the alignment would continue west toward Cambridge following the Freight Cutoff right-of-way as shown in Figure II-1C. Except for a 1,200-foot radius section just west of the Davis Square Station, the alignment would be on a tangent section up to Magoun Street, where it would turn southwest on a 1,000-foot radius and cross Harvey Street and Russell Field to reach the Alewife Station.

From the end of Alewife Station, the alignment would turn on a 400-foot radius through the Alewife area, entering the existing Boston and Maine Lexington Branch right-of-way as quickly as possible to minimize impacts to environmentally sensitive lands within the Alewife Brook Reservation. After the alignment enters the railroad right-of-way, it would run on a northwesterly tangent under Route 2. Turnback and storage facilities for the Alewife Station would be located in this section extending to a point about 535 feet north of Route 2.

This alignment was selected because it minimizes land takings, business displacements and infringement on the environmentally sensitive lands of the Alewife Brook Reservation while allowing the station platform to be located such that it is equally accessible from the "industrial triangle", described in the land use section of this chapter, and from the surrounding residential neighborhoods of North Cambridge and East Arlington.

At the Davis Square Station, the trackbed would be about 45 feet below grade. The tunnel floor would then rise to about 35 feet below grade at Day Street. From there, it would remain at 25 to 30 feet below ground to the Alewife Station. Tunnel construction costs would be minimized at these depths.

From Alewife to Route 2 the alignment would be at a maximum depth of approximately 32 feet, allowing adequate cover between the tunnel section and Alewife Brook.

Ventilation shafts would be located along the alignment between the Davis Square and the Alewife stations at approximately the following locations:

- MBTA Lexington Branch right-of-way near Elmwood Street
- MBTA Lexington Branch right-of-way near Jackson Street.

An alternative single location just west of Massachusetts Avenue on railroad right-of-way will be studied in later design phases. A traction power substation will be located in the area. Several sites are being considered including East Entry and garage building.

Station

Entry and Exit Points

Entrances to the below grade Alewife Station would be located at both ends of the station platform, which would be approximately 440 feet in length and 35 feet in width. (See Figures VI-2 through VI-5).

A kiosk would be constructed at the east entrance, just west of Russell Field and north of Lehigh Metal Products on what is now vacant land owned by W. R. Grace, Inc. There will be a pedestrian underpass under Alewife Brook Parkway to the bus platform and garage. Although planned as a free standing entrance, the east entrance could become an integral part of any new development on or redevelopment of the W. R. Grace property. The east entrance would be used primarily by persons walking in from North Cambridge, especially residents of Jefferson Park and Rindge Towers, and by employees of W. R. Grace or persons connected with any new development that may occur on the vacant property. The east entrance would also provide excellent access to the Russell Field complex.

The west entrance would be the main entrance to the station and would serve most of the park-and-ride, kiss-and-ride and bus patrons. The west entrance would be located in the parking garage, with the lobby being one level below grade. The station platform would be at the east end of the lobby and two levels below grade. Stairways, escalators and elevators would connect the platform to the lobby and then to the bus loading/unloading and parking facilities above. This west entrance would also be connected by walkways and pathways to working and shopping destinations at Alewife, facilitating easy access for rapid transit users.

Stairs/Elevators/Escalators

Stairs and escalators would be located at both station entrances. Preliminary designs call for one combination stairway/escalator at the east entrance and seven stairways with five escalators and one ramp at the west entrance, bus platform, and kiss-and-ride. The size and number of these facilities has been based on the ultimate boarding forecasts.

Elevators would be provided at the west entrance to facilitate pedestrian movement from the upper levels of the parking garage to the lobby, particularly for handicapped users.

Provisions for Handicapped and Elderly

Handicapped and elderly patrons would have access to the station platform via elevators at the west entrance which would be accessible via the pedestrian underpass from the east. Elevators could be placed at the east entrance if air rights above the entrance are utilized in connection with the possible redevelopment of the W. R. Grace property or if general usage requires. Provisions to accommodate handicapped persons such as wide fare collection gates and ramped curbs would be a part of the final design. Ultimately, handicapped persons would be able to move freely from the parking garage or from the ground level to the station platform with minimum difficulty. All handicapped facilities will be designed in accordance with UMTA guidelines.

Fare Collection

Fare collection facilities would be located at the east and west entrances. The number of boardings at the east entrance would determine whether or not the fare collection facility would be operated during all station hours. The east entrance might only be manned during peak hours in the initial years of Red Line service. Full-time service would be provided if warranted by user demand.

Pedestrian Access

Both station entrances would be connected to the pedestrian circulation network (proposed for development as part of the Alewife Linear Park) by pathways and bikeways. All pathways and bikeways would be paved and lighted and designed in accordance with MBTA standards for construction of pedestrianways. Appropriate facilities would be provided in the garage for long- and short-term bicycle parking. The surrounding areas would be landscaped for screening, fencing, and esthetic purposes. Particular attention would be given to developing attractive and pleasant approaches to the station/garage complex for both the pedestrian and the automobile or bus passenger.

Intermodal Connections

If the project is constructed as proposed, transfers between the Red Line Extension and the commuter rail lines would be made at the Porter Square Station. If an additional commuter rail station is constructed at Alewife on the Fitchburg Main Line beneath the Parkway Bridge, a pedestrian walkway would be developed as part of the proposed Alewife Linear Park to link this facility with the proposed Alewife Station complex.

External Emergency and Ventilation Shafts

Ventilation and emergency shafts would be required for the Alewife Station. These would be located to minimize impact to the above ground environment. Preliminary plans call for a shaft opening on the surface in the area of the east entry and another opening west of Alewife Brook Parkway at the north and west face of the proposed parking garage.

Bus Handling Facilities

All bus loading/unloading would occur at ground level beneath the upper parking garage levels. Escalators and stairways would provide quick access from the bus platforms to the station lobby and platform. Additional temporary layover facilities would be provided in the form of an additional lane east of the bus platform. Bus storage or maintenance facilities would not be provided at the Alewife Station complex. Buses making terminal runs to the station would proceed to other MBTA facilities for overnight storage or repair and maintenance work. The station will have 14 bus berths and a peak hour capacity for 55 to 64 buses.

As is the case with other MBTA bus loading/unloading operations at transit stations, bus fares would not be collected at the station. This procedure allows for expeditious loading and unloading of buses and minimizes bus turnaround times at the station.

Parking Garage

The proposed parking garage at Alewife Station would accommodate approximately 2,000 park-and-ride vehicles, staff parking spaces for 50 to 100 vehicles, and between 60 and 150 kiss-and-ride vehicles. The structure itself would be approximately 630' x 324', with five levels. The garage would have an expansion capability of 1,000 parking spaces and two levels.

Kiss-and-ride facilities would be located at ground level and would consist of free and possibly short-term metered spaces. Park-and-ride spaces would be provided on the upper levels. There would be one fee for long-term parking, payable upon entering the garage. Park-and-ride traffic would enter and leave the garage via two double spiral ramps and exit at the ground level along with bus and kiss-and-ride traffic.

Design of the parking structure reflects both functional and esthetic considerations. Internally, the garage design would represent fullest utilization of space and provide maximum convenience for the user. Externally, scale and visual appearance will be given priority during final design.

Vehicular Access

All vehicular access to the Alewife Station/Garage Complex would be from existing streets--Rindge Avenue Extension and/or Alewife Brook Parkway. This assumes that the MDPW would not build a new connector road from Route 2 to Rindge Avenue Extension. With access only from existing streets, all buses, kiss-and-ride and park-and-ride traffic would enter the site through the signalized Alewife Brook Parkway and Rindge Avenue intersection. All vehicular access at the garage would be at ground level. Internal garage ramping would provide park-and-ride access to the upper floors.

A discussion of vehicular access in the event that the MDPW should build its proposed connector road appears on pages VI-20 to VI-24.

Turnback and Lay-up Facilities

Outbound of the Alewife Station an additional parallel track and crossovers will provide turnback capability and an initial lay-up capacity for 36 Red Line cars. The three-track tunnel will extend to a point between Route 2 and Arlington Center. The reach across Alewife Brook Reservation to Route 2 is included in this chapter. The reach north of Route 2 is discussed in Chapter VII.

The three-track tunnel would be approximately 45 feet wide outside-to-outside of walls and the roof would typically be about 12 feet below grade level. A yardman's lobby would be located in the tunnel near the Alewife Station.

Right-of-Way Requirements

This section of the project would be constructed along railroad rights-of-way and across Russell Field and other private properties. A number of permanent easements and land takings would be required. The specific properties involved and the type of taking or easement required are indicated in Table VI-1.

Table VI-1

RIGHT-OF-WAY REQUIREMENTS
DAVIS SQUARE TO ALEWIFE (Rte. 2)

Address	Type	Use
Somerville		
65 Meacham Road	Commercial	Permanent & Construction Easement
67 Meacham Road	Commercial	Permanent Easement
69 Meacham Road	Commercial	Total Taking
11 Lester Terrace	Residential	Construction Easement
38 Thorndike Street	Residential	Construction Easement
41 Thorndike Street	Residential	Construction Easement
43-45 Thorndike Street	Residential	Construction Easement
25 Kingston Street	Residential	Construction Easement
27-29 Kingston Street	Residential	Construction Easement
31 Kingston Street	Residential	Construction Easement
33 Kingston Street	Residential	Construction Easement
35 Kingston Street	Residential	Construction Easement
37 Kingston Street	Residential	Construction Easement
43 Kingston Street	Residential	Construction Easement
6 Campbell Park Place	Residential	Construction Easement
42 Locke Street	Residential	Construction Easement
Rear Howard Street	Industrial	Construction Easement
39 Thorndike Street	Residential	Construction Easement
Lot 98 Buena Vista Rd.	Vacant	Construction Easement
Cambridge		
42 Locke Street	Residential	Construction Easement
42-46 Locke Street	Residential	Construction Easement
48 Locke Street	Residential	Construction Easement
2409 Massachusetts Avenue	Commercial	Construction Easement
2464 (Rear) Massachusetts Avenue	Industrial	Construction Easement
35 Harvey Street	Residential	Construction Easement
45 Harvey Street	Commercial	Construction Easement
2448-2464 Massachusetts Ave.	Commercial	Partial Taking

Table VI-1 (continued)

Address	Type	Use
Cambridge (continued)		
173 Harvey Street	Industrial	Construction Easement
149-163 (Rear) Harvey Street	Industrial	Construction Easement
End Harvey Street	Industrial	Construction Easement
128 Clifton Street	Residential	Construction Easement
222 Harvey Street	Industrial	Permanent Easement
End Harvey Street	Industrial	Permanent Easement
124 Clifton Street	Industrial	Permanent Easement
82-124 (Rear) Clifton Street	Recreational	Permanent Easement
Metropolitan Parkway	Industrial	Permanent Easement
End Harvey Street	Industrial	Permanent Easement
121-123 Alewife Brook Parkway	Commercial	Total Taking
465-467 Rindge Avenue	Commercial	Total Taking
527-559 Rindge Avenue	Commercial	Total Taking
520-560 Rindge Avenue	Industrial	Total Taking
25 Rindge Avenue Extension	Commercial	Total Taking
35 Rindge Avenue Extension	Industrial	Partial Taking
Alewife Brook Reservation	Open Space	Permanent Easement
196 Rindge Avenue Extension	Commercial	Construction Easement

Construction Considerations

Tunnel/cut-and-cover construction would be utilized for this section of the project. Intersections at Cameron Avenue, Cedar Street and Massachusetts Avenue would require decking during construction to permit the uninterrupted flow of vehicular and pedestrian traffic.

Where construction underpasses Alewife Brook Parkway, a short by-pass roadway would be constructed on an earth embankment adjacent to the Parkway. The temporary detour will permit uninterrupted traffic flow while a section of the station and a pedestrian underpass is constructed and the original roadway is restored.

It is projected that tunnel construction under Route 2 can be accomplished without disturbing the roadway. An existing highway bridge spans the tunnel alignment and it is anticipated that underpinning techniques will stabilize the bridge piers against stresses caused by the tunnel construction.

Cut-and-cover construction between Alewife Station and Route 2 would require temporary relocation of Alewife Brook, Little River and Yates Pond outlet prior to excavation. Once the box section for the tunnel has been completed and covered over, these would be relocated to their original channels or locations acceptable to the MDC.

It is possible that the railroads (Freight Cutoff and Lexington Branch) may not be abandoned prior to the start of construction. In that eventuality, the railroads would be relocated within the existing right-of-way in most locations. Across the Alewife Brook Reservation, due to the existing Route 2 Bridge, the railroad will infringe on the Reservation.

There are several utilities along the alignment that will be affected by the tunnel/cut-and-cover. It is proposed that most utilities can be supported over the tunnel or relocated within the same area. Some of the major utilities include: 48" x 52" combined sewer located parallel to railroad right-of-way at Davis Square; 345 Kv PTC power lines belonging to Boston Edison at Thorndike Street, Somerville; at Massachusetts Avenue-Cameron Avenue-Cedar Street area, 20" gas, 24" storm drain, electrical ducts, 15" sanitary sewer, 32" x 36" combined sewer, 24" x 32" combined sewer; a 30" x 41" combined sewer at Montgomery Street; at Alewife Brook Parkway, 345 Kv PTC Boston Edison power lines; at Rindge Avenue Extension 48" combined sewer; 36" storm drain at Freight Cutoff; 23" x 33" combined sewer at Freight Cutoff and Lexington Branch; 66" MDC Alewife Brook conduit and 54" inverted siphon across the Alewife Brook Reservation; and 26" high pressure gas line at Route 2.

The alignment's close proximity to Route 2 and Massachusetts Avenue would permit easier materials handling for this phase of tunnel/cut-and-cover construction. The Fitchburg Freight Cutoff right-of-way could be utilized for a construction access road to facilitate the movement of construction equipment and the removal of waste materials to and from Route 2 and Massachusetts Avenue.

Cut-and-cover construction from Davis Square to Alewife/Route 2 and construction of the Alewife Station complex would occur simultaneously over a period of approximately 36 months.

Table VI-2

ESTIMATED CONSTRUCTION TIME

Construction Phase	Time in Years				
	1st yr.	2nd yr.	3rd yr.	4th yr.	5th yr.
Davis Square to Alewife		■	■	■	
Alewife Station and Garage		■	■	■	

Costs

Table VI-3 presents an itemized breakdown of construction costs for the Davis Square to Alewife section, beginning at the end of the Davis Square Station and terminating north of the Alewife Station (about 535 feet north of Route 2). The costs do not include project wide items such as floating slabs, trackwork, ventilation, electrification, signalization and communications. For these costs see Chapter II. The estimate is based on midpoint of construction Dollar value.

Table VI-3

CONSTRUCTION COST ESTIMATES
DAVIS SQUARE TO NORTH OF ALEWIFE
(Costs do not include project wide items)

MAC Code	Item (Tunnel/Cut-and-Cover)	Amount		Cost
15.13.20	Tunnel Structure	$36,720,000		
15.13.10.12	Relocate Utilities	406,000		
15.13.10.11	Relocation of RR Tracks	7,853,000		
15.13.10	Demolition	138,000		
			$45,117,000	
15.06.10	Right-of-Way	70,000		
			70,000	
15.08.01	Professional Services	2,201,000		
15.15.02	Field Inspection	1,360,000		
15.15.02	Force Account	880,000		
15.16.00	Project Administration	2,797,000		
			7,238,000	
	Subtotal			$52,425,000
32.00.00	Contingencies			4,402,000
	Total			$56,827,000

Alewife Station/Garage Complex (Cut-and-Cover)

MAC Code	Description	Amount		
15.11.10	Station Structure	$ 8,303,000		
15.11.40	Garage, Site Access			
15.11.90	& Bus Station	24,723,000		
15.13.10.11	Remove & Relocate RR Track	236,000		
			$33,262,000	
15.06.10	Right-of-Way	2,000,000		
31.00.00	Relocation	300,000		
			2,300,000	
15.08.01	Professional Services	2,314,000		
15.15.02	Field Inspection	1,023,000		
15.15.02	Force Account	661,000		
15.16.00	Project Administration	2,121,000		
			6,119,000	
	Subtotal			$41,681,000
32.00.00	Contingencies			3,306,000
	Total			$44,987,000
	Total for Segment			$101,814,000

ALTERNATIVES

Line Segments

In addition to the proposed alignment for the line segment between Davis Square and Alewife, three alternative alignments were considered. These alternatives differ from the proposed alignment only in that the MBTA Freight Cutoff tracks would not be eliminated, but would be shifted on top of,or adjacent to,the proposed transit line.

The first alternative would maintain in the Freight Cutoff Railroad tracks at existing grade during and after tunnel construction. New track would be connected to the existing tracks about 200 feet east of Davis Square and would then extend across a portion of the tunnel/deep bore and continue along the new subway alignment on top of,or adjacent to,the new subway structure. The possibility of keeping the track adjacent to the proposed subway for the length of the segment was considered; however, due to the extensive right-of-way acquisitions required, that option was discarded.

At a point near Harvey Street, the new railroad tracks would diverge from the transit alignment and meet the existing tracks. Due to the location of the railroad on top of,or adjacent to,new construction, careful consideration would be required in the design of excavation, support and bracing and/or a railroad track support system. The latter would have to be designed to minimize disruption of rail service. The method, sequence and duration of construction for this alternative would be approximately the same as that for the proposed alignment, except for the method of construction which would be utilized at the cut-and-cover portion under the railroad. Here, one cell of the double box could be completed without interfering with existing rail traffic. Rail operations could then be shifted to the completed construction and the other cell could be constructed. This alternative would cost an additional $900,000 (1975 Dollar values), including other project costs. Another disadvantage would be the additional right-of-way requirements, affecting both private residences and industrial property.

The second alternative would also maintain existing rail service without disruption; however, the railroad would be depressed, with retaining walls, adjacent to the north side of the proposed subway. With the top of the tracks at Davis Square 40

feet below existing grade and on a gradient of 0.65 percent, the new track would meet the existing track grade approximately 6,000 feet from the proposed Davis Square Station starting point; i.e. at Lowell Street on the east and at W. R. Grace, Inc. on the west. The new railroad line would be completed and put into service prior to removal of existing track and new subway construction. This alternative would cost an additional $30,760,000, (1975 Dollar value), including other project costs. The high cost is due to the long distance required to meet the desired underground level of track. Additional right-of-way would be required.

The third alternative considered was a tunnel/deep bore from Davis Square to the proposed Alewife Station. This scheme would eliminate the effects of surface construction; however, the additional cost of this alternative--$29,390,000 (1975 Dollar value) more than the tunnel/cut-and-cover scheme--would be a major disadvantage.

Station

The three alternative station locations originally developed in the BTPR Study were reviewed and re-examined in the context of current issues relevant to an Alewife Station. An updated analysis was made of the potential impacts of the station and garage at the three different locations. These impacts were summarized and categorized in a matrix which served as the basis for further analysis of the implications of each alternative. This summary matrix is shown in Figure VI-6.

Station Location A, as shown in Figure VI-7 is bounded by Alewife Brook Parkway, the Fitchburg Main Line, Rindge Avenue, and the MBTA Lexington Branch. This location was rejected early in the analysis due to its inability to accept a rail alignment from the Davis Square Station. When this location was originally proposed in the BTPR Study, no final decision had been made on locating a station at Davis Square. Since that time, the City of Somerville and the Davis Square TAG have endorsed a Davis Square Station and the extension of the Red Line through Somerville. With a station at Davis Square, it would be impractical to pass an alignment through Station Location A to extend the line to Arlington. Conversely, construction of the Alewife Station at Location A would require acceptance of either the Fitchburg Main Line or the Garden Street alignments, thus precluding a station at Davis Square.

One advantage of a station at Location A would be its proximity to the Fitchburg Main Line, which would permit easy transfer between the Red Line Extension and commuter rail service on this line; however, this would not be the only place where an intermodal transfer could be made. In fact, plans for the Porter Square Station include provisions for cross transfer at that station.

Station Location C (see Figure VI-9) would be directly east of the Dewey and Almy Circle on land currently occupied by the W. R. Grace, Inc., industrial complex. The station platform would lie along the rail spur which serves W. R. Grace, Inc. from the Fitchburg Freight Cutoff. Advantages and disadvantages of a station at Location C were discussed in detail at Alewife Task Force meetings. Two major advantages of Location C are that it would provide the best alignment geometry and that it would have a minimum impact on the environmentally sensitive areas of the Alewife Brook Reservation; however, Station Location C is adjacent to the residential neighborhoods of North Cambridge and East Arlington, and as a result, the potential for a major change of neighborhood character and a decline of the quality of living within the neighborhoods would be present if a station and garage were developed there. Other disadvantages of this location would be the potential visual impact and traffic congestion problems associated with the three-level, grade-separated interchange that would be required to feed automobile and bus traffic to a garage at the station. In addition, a station at this location would require the taking of a substantial number of industrial structures resulting in a large displacement of workers. Also, Location C would not provide easy access to the "industrial triangle" area--which the City of Cambridge would like redeveloped. Further, the track alignment from Station Location C to Arlington would pass relatively close to residential structures within East Arlington, which would result in noise and vibration impacts to these residences. Current plans of the Town of Arlington call for purchase of the abandoned railroad right-of-way which coincides with this proposed alignment out of Station Location C.

Station Location B (see Figure VI-8), like Station Location C, has several advantages and disadvantages; however, the Alewife Task Force unanimously selected it over Station Location C for the following reasons:

- Station Location B would be separated from the residential neighborhoods of North Cambridge and East Arlington by the highway network and the proposed Alewife Linear Park, but still would be within walking distance of a large number of neighborhood residences.

- Station Location B is located within the "industrial triangle" and would afford easy access to potential redevelopment in this area.

- Residents of East Arlington would have better access to a station at Location B because of the proposed use of the Lexington Branch right-of-way as a linear park with pedestrian walkways.

- Station Location B would require more property and business takings in terms of land area and numbers, but less total takings in terms of assessed valuation and displacement of jobs.

One disadvantage of Station Location B is that it is closer than Station Location C to the ecologically sensitive areas of the Alewife Brook Reservation which could be potentially impacted by the garage. Mitigating measures would be undertaken to the fullest to eliminate any potential impact. Specifically, a landscaped buffer would separate the station area from the reservation and retention ponds would be constructed to accommodate storm water runoff.

After Location B was selected over Location C, five modified alternatives of the station platform location and track alignment were developed and again reviewed with the Alewife Task Force (see Figure VI-10). Alternative B5 (slightly modified during pre-grant engineering) was selected for final station location for the following reasons:

- The B5 alignment would furnish the best access to both the "industrial triangle" and the North Cambridge and East Arlington neighborhoods.

- The B5 alignment follows the existing MBTA Lexington Branch right-of-way out of the station going west, thereby minimizing impacts to the Alewife Brook Reservation.

- The B5 alignment would provide an opportunity to create an open space connection between the Reservation, Arlington's proposed linear park and the Russell Field complex, thus contributing significantly to the development of the Alewife Brook Linear Park concept.

Garages

Four parking garage alternatives were developed and analyzed in the following terms: estimated costs for construction, operation and maintenance; potential impacts on the watershed - specifically the amount of increased runoff; potential impacts on the environmentally sensitive lands surrounding the proposed garage site; and compatibility with the proposed Route 2 and Alewife Brook Parkway improvements. The four alternatives were as follows:

1) A single garage, with a capacity of 1,000 - 2,000 cars, located on the site enclosed by Alewife Brook Parkway, Rindge Avenue Extension, the MBTA Lexington Branch and the Freight Cutoff.

2) Two separate "split" garages, each with a capacity of 1,000 cars, with one garage located on the site of Alternative One and the other garage located on a site east of the Parkway on the W. R. Grace, Inc. property.

3) Two separate "split" garages, each with a capacity of 1,000 cars, with one garage located on the site of Alternative One and the other located at an unspecified site along Route 2 west of A. D. Little, Inc.

4) A "no garage" alternative that would provide kiss-and-ride and bus loading/unloading facilities.

The Alewife Task Force assisted in developing the alternatives through extensive deliberations at meetings. A questionnaire on garage size and location was prepared for distribution to Task Force members. Of 105 questionnaires sent out, 31 were returned and tallied with the following results:

1) It appears that 2,000 commuter parking spaces is a compromise figure that most members of the task force will be willing and able to support. Twenty people preferred fewer than 2,000 commuter spaces, while eleven people preferred more than 2,000. The exact breakdown by preference showed that one person favored no garage, one person favored a garage for less than 500 cars, 3 persons favored a garage for 500-1000 cars, 15 persons favored one for 1,000 to 2,000, 9 persons favored one for 2000-3000 cars, and two persons wanted a garage for more than 3,000 cars.

2) The arguments favoring 2,000 spaces or less that were most often cited as being persuasive were:

- The abutting neighbors in Cambridge are fearful that more than 2,000 commuter parking spaces will cause significant disruption to their neighborhoods.

- The more spaces there are, the more our dependence on the automobile will increase.

- The congestion in Alewife at peak hours would be unbearable if more than 2,000 commuter parking spaces were provided.

- The City of Cambridge (City Council) has gone on record as opposing a facility with more than 2,000 commuter spaces.

3) The arguments favoring more than 2,000 spaces that were most often cited as being persuasive were:

- The Alewife Station is a regional facility, and should accommodate as many commuter spaces as possible (certainly more than 2,000).

- The more spaces there are, the better chance there is of keeping automobile traffic out of downtown Boston.

4) There was not much support for the "no garage" alternative or for either of the "split" garage alternatives.

Impacts

Alternative One, consisting of a single garage for 1,000 - 2,000 cars on the site bounded by Alewife Brook Parkway, the MBTA Lexington Branch, the Freight Cutoff, and the Rindge Avenue Extension, would be the least expensive of the garage alternatives. If direct access were to be provided from Route 2, a one-lane inbound ramp and a one-lane outbound ramp would be needed to accommodate the projected 1540 vehicles which would be entering and exiting during peak hours. Approximately 470 vehicles are projected to exit onto Alewife Brook Parkway from Rindge Avenue Extension during the evening peak-hour. Through traffic lanes would be additional to these. Of the garage solutions, a single garage would require the fewest land takings and would generate the least amount of additional storm water runoff.

Alternative Two, consisting of two separate parking garages--each accommodating 1,000 vehicles--would be more expensive to construct. This alternative would require additional land takings and duplication of ramp structures and collection facilities, with increased maintenance costs over those for a single structure. Additional storm water runoff would be generated because of the loss of retention areas. Visually, the two garages would be less intrusive than one garage, if they are sufficiently separated. Under Alternative Two, the grade separation of the Rindge Avenue/ Alewife Brook Parkway intersection could possibly be avoided.

Alternative Three, also consisting of two 1,000-car garages, would have impacts similar to those anticipated under Alternative Two. The cost for this alternative would be increased because of the requirements for shuttle bus service between the garages and the station and the resulting increase in travel time for the commuter. Less congestion would occur than under the first two alternatives because of the separation of commuter vehicular traffic.

Alternative Four would provide only kiss-and-ride and bus loading/unloading facilities with no parking garage and would be the least expensive alternative. However, due to the large paved surfaces needed to accommodate the increased numbers of kiss-and-ride vehicles, impervious surface area requirements would be approximately the same as for a park-and-ride facility. If all park-and-ride converted to kiss-and-ride, a two-lane inbound ramp from Route 2 and a two-lane outbound ramp to Route 2 would be required and the Rindge Avenue-Alewife Brook Parkway intersection would have to be grade separated to accommodate the large numbers of kiss-and-ride users. If all park-and-ride vehicles are accommodated elsewhere, the grade separation would still be required; however, the Route 2 ramps could be eliminated.

In either case, large numbers of park-and-ride vehicles would seek to park on local streets and in business parking lots unless a parking sticker program is implemented. This situation, where park-and-ride demand exceeds supply, exists with all alternatives, but it would be greatest for Alternative Four (the "no garage" alternative). The diversion of park-and-ride vehicles to other stations would place increased demands on the parking facilities at these stations, resulting in additional traffic congestion.

Vehicular Access to the Garage

As was mentioned earlier on page II-145b, the Massachusetts Department of Public Works (MDPW) is concurrently developing plans for roadway improvements in the Alewife area. One aspect of the highways agency's proposal is to provide direct access from Route 2 to the MBTA's parking garage. While the MBTA has been coordinating with the MDPW and is prepared to have access from the MDPW ramps, the MBTA's project calls for the construction of the garage and station at Alewife with provisions for access from existing local streets and does not include the proposed highway improvements.

The major features of the proposed MDPW improvements, which are summarized here for reference purposes, include:

- Elimination of direct access to abutting land-use development on both sides of Route 2 (Concord Turnpike), and reconstruction and minor relocation of Route 2, between the Lake Street interchange and Dewey-Almy Circle. Provision of replacement access to southside Route 2 development via a connection from Acorn Park Road.

- Direct roadway connections between Route 2 and the Rindge Avenue Extension, which provides access to the "Industrial Triangle".

- Replacement of the substandard bridge over the Boston and Maine Freight Cutoff on the Alewife Brook Parkway.

- Improvement of the existing at-grade, signalized intersection of the Alewife Brook Parkway and Rindge Avenue through realignment, new signalization, and channelization.

- Improved access to the proposed MBTA Red Line Extension Station/garage at Alewife.

If the improvements are eventually approved by the Federal Highway Administration and if the MDPW implements the roadway connector between Route 2 and Rindge Avenue, the connector ramps will serve to provide primary access to the MBTA's garage. Secondary vehicular access would be from the Rindge Avenue Extension. See Figures VI-2 and VI-3. The details of the MDPW's proposed improvements are set forth in its report entitled Environmental Overview Summary Update, which is attached in its entirety to this EIS as Appendix J.

Between the Lake Street interchange and the proposed direct connections from Route 2 to the Rindge Avenue Extension, Route 2 will consist of three travel lanes in each direction to effect a proper transition between the four-lane directional cross-section for Route 2 west of Lake Street and the two-lane directional approaches of Route 2 to the Alewife Brook Parkway at the Dewey-Almy Circle intersection. In addition, an auxiliary weaving lane will be required for the outbound travel direction to safely accommodate weaving which will occur between Route 2 westbound traffic desiring to exit at the Lake Street interchange and Rindge Avenue Extension outbound traffic desiring to proceed westward on Route 2.

The new direct connections between Route 2 and the Rindge Avenue Extension are intended to provide improved access to Cambridge's Industrial Triangle area, an area presently characterized by predominantly industrial uses, but with potential for various higher-intensity industrial, commercial, and other uses. They are also intended to provide direct connections from Route 2 to the MBTA station/garage. These connections generally follow the right-of-way of the MBTA Commuter Railroad's Lexington Branch from Route 2 to the Rindge Avenue Extension. Inbound from Route 2, the new ramp connection will begin to diverge from existing Route 2 in the approximate vicinity of the Chalet Motor Inn on the south side and cross through the MDC's Alewife Brook Reservation and the Little River on viaduct before it meets existing grade in the vicinity of the MBTA Commuter Railroad's Freight Cutoff. The inbound connection then continues at approximately existing grade to Rindge Avenue Extension. Outbound from Rindge Avenue Extension to Route 2, the new outbound connection maintains the same profile, at approximately existing grade, between Rindge Avenue Extension and the Freight Cutoff; also crosses the Alewife Brook Reservation and the Little River predominantly on viaduct; and passes beneath Route 2 and merges with Route 2 westbound in the vicinity of the boundary between the Thorndike Street Playground and property owned by the Mugar Group. The profiles of the Route 2 connectors north of the Freight Cutoff have been established to allow for a pedestrian and bicycle underpass beneath them to avoid encroachment of the outbound connection into the Thorndike Street Playground, a potential Section 4(f) land, the alignment of Route 2 in this vicinity has been shifted southward toward ADL and the Alewife Brook Reservation, where encroachment cannot be avoided. The cross-section of the Route 2 - Rindge Avenue

Extension connector generally consists of two 12-foot travel lanes in each direction with exclusive left-turn storage lanes and channelization at the MBTA station/garage to facilitate access. The Rindge Avenue Extension - Route 2 Connection intersection will be signalized and coordinated with new signalization at the improved Rindge Avenue - Alewife Brook Parkway intersection and with signalization and signing of the various station/garage access points. Railroad preemption devices will be provided at all at-grade railroad crossings in this area.

Route 2 eastbound and westbound, in the vicinity of the MBTA Commuter Railroad's Lexington Branch (Rindge Avenue Extension connections) to the Alewife Brook Parkway at Dewey-Almy Circle, will each consist of three 12-foot travel lanes with shoulders, and will cross the MBTA Commuter Railroad's Lexington Branch, the outbound connection from the Rindge Avenue Extension and the Alewife Brook on viaduct. To increase traffic safety at Dewey-Almy Circle, consistently one of the most hazardous (high-accident) locations in Massachusetts, the substandard rotary will be replaced by a signalized, channelized, at-grade "T"-intersection and will be raised in grade approximately five feet to improve vertical sight distances on both the Alewife Brook Parkway and Route 2 at their approaches to this intersection. The Alewife Brook Parkway approaches to this intersection will consist of two 11-foot travel lanes with a shoulder. The Route 2 eastbound approaches at Dewey-Almy will consist of two 12-foot travel lanes with shoulders for Parkway southbound traffic and one 12-foot travel lane with shoulders for Parkway northbound traffic.

North of the signalized "T"-intersection at Dewey-Almy, the four improved traffic lanes will meet the existing Parkway cross-section before Massachusetts Avenue. Access to Whittemore Avenue will basically remain unchanged; however, the intersection will be signalized and coordinated with signalization at the Parkway/Route 2 intersection. South of the Dewey-Almy intersection, the existing substandard and deteriorated four-lane, 40-foot curb-to-curb bridge over the MBTA Commuter Railroad's Freight Cutoff will be replaced by a new bridge with four 11-foot travel lanes, shoulders, and sidewalk. This cross-section will be continued southward to an improved Rindge Avenue intersection.

The approaches to the existing Rindge Avenue/Rindge Avenue Extension intersection will be realigned, widened to accommodate some traffic movements, and channelized, for safety purposes and to prohibit or restrict other traffic movements. Specifically, the Rindge Avenue Extension approach to the Parkway will be realigned northward to create a so-called "dogleg" intersection. To facilitate access to the MBTA station/garage and other Rindge Avenue Extension development from the north on the Parkway, a free right-hand-turn lane will be provided at the southbound approach to the intersection. Access into Rindge Avenue from Alewife Brook Parkway will be prohibited from the north (as presently exists today), and as a result of realignment and channelization, from Rindge Avenue Extension (which is presently permitted). These improvements will decrease this residential street's use as a short cut into Cambridge and Boston by traffic from the northwest. Such treatment of this intersection is an expressed desire of Cambridge city officials and the North Cambridge Neighborhood itself. Access to Rindge Avenue from the Alewife Brook Parkway will only be permitted from the south.

The proposed project terminates on the Alewife Brook Parkway just north of the trestle bridge over the MBTA Commuter Railroad's Fitchburg Branch. To accommodate the proposed direct connection between Route 2 and the Rindge Avenue Extension, a portion of the MBTA's Lexington Branch Line to the south of the Freight Cutoff will be relocated. In addition, rail spur access to Bethlehem Steel, located on the Rindge Avenue Extension adjacent to the new connection, will be relocated from the Lexington Branch to the Freight Cutoff. Both rail relocations are included as part of the Minimum-Build Alternative.

Whether or not these improvements occur, the MBTA will proceed with garage and station construction at Alewife with provisions for access from existing local streets.

Traffic Related Impacts

Traffic flow problems presently occur at the Dewey and Almy Circle as well as on the approaches of the Alewife Brook Parkway and Route 2. The MDPW updated Environmental Overview Summary for the Route 2 Project (see Appendix J) indicates that the level of service at the Dewey and Almy Circle during the morning and evening peak periods is at "Level F" (traffic conditions characterized by forced flow and jammed operation, with speeds less than 15 mph). Alewife Brook Parkway, south of the Circle, is at Level of Service D (characterized by unstable flow, delay and a minimum speed of 15 mph) during the morning peak hour. Route 2, west of the Circle, is at Level of Service B (stable flow with only slight delays) during both peak periods. The introduction of additional peak hour vehicles in the area would contribute to existing traffic flow deficiencies. Only those vehicles approaching the station from the north (about 300 during the morning peak hour) would pass through the Dewey and Almy Circle. Vehicles approaching from the west via Route 2 (approximately 1,540 during the morning peak hour) would mix with the volumes in the direction of the heaviest flow but would be intercepted at the station entrance ramps west of the Circle. Traffic approaching the station from the south via Alewife Brook Parkway (approximately 150 vehicles during the morning peak hour) would also enter the station prior to encountering the Circle and would be moving in the opposite direction of the heaviest flow.

Existing Conditions

The proposed station at Alewife would be served by two major highways: Alewife Brook Parkway from the north and south, and Route 2 from the west. Table VI-4 shows the estimated 1975 Average Daily Traffic (ADT) and forecasted 1980, 1985 and year 2000 ADT on these routes without station generated traffic.

Table VI-4

ESTIMATED AVERAGE DAILY TWO-WAY TRAFFIC
ALEWIFE BROOK AREA*
(does not include station generated traffic)

Route	1975	1980	1985	2000
Alewife Brook Parkway (North of Dewey-Almy Circle)	32,200	36,850	38,500	40,570
Alewife Brook Parkway (South of Dewey-Almy Circle)	48,900	56,710	58,100	62,290
Route 2 (W)	44,500	58,600	61,600	70,380

* Based on figures presented in Environmental Overview Summary, Fay, Spofford & Thorndike, Inc., July 1975.

The BTPR Study identified traffic flow problems in the Alewife area. One major problem is at the intersection of Route 2 and the Alewife Brook Parkway at the Dewey and Almy Circle. Large traffic volumes, the Circle's small diameter, and direct access to adjacent areas combine to create substantial traffic congestion here. In addition, Route 2 narrows from an eight-lane expressway to a four-lane arterial approximately 3000 feet before the Circle. Traffic flow problems are currently being studied by the Massachusetts Department of Public Works and their consultant, Fay, Spofford & Thorndike, Inc. Appendix J presents an updated Environmental Overview of their studies. The City of Cambridge is presently concluding a traffic study of the area. Some of their figures are included in this chapter.

Existing pedestrian volumes are not substantial in the immediate area of the Dewey and Almy Circle. The BTPR noted pedestrian crossing hazards west of the Circle along Route 2 and south of the Circle along Alewife Brook Parkway.

Existing bus service in the area consists of 5 routes with 16 peak hour arrivals. The most popular service is the 83 bus which travels between a turn-a- round at Russell Field and Central Square via Rindge Ave.

MBTA commuter rail service through Alewife does not currently stop at Alewife. At one time Fitchburg Mainline trains stopped for passengers at a station beneath the Alewife Brook Parkway Bridge. This service was discontinued about 1938.

Station Boardings

It is estimated that the extension of the Red Line to Route 128 would generate approximately 8,200 inbound boardings per day at the Alewife Station. If the Red Line Extension terminates at Alewife, there would be approximately 11,750 total boardings per day. Table VI-5 shows estimated 1980 daily inbound boardings at the Alewife Station by mode of access for each alternative terminus.

Table VI-5

ESTIMATED 1980 INBOUND BOARDINGS*
ALEWIFE STATION

	Mode of Access				
Alternative Terminus	Walk-In	Kiss-and-Ride	Bus	Park-and-Ride	Total
Route 128	1,960	1,660	2,070	2,520	8,210
Arlington Heights	1,960	1,720	2,140	2,520	8,340
Alewife	1,960	2,640	4,630	2,520	11,750

*Source: CTPS

Table VI-6 shows the expected auto arrivals at Alewife Station during peak-hours, by access route, under each alternative terminus.

Table VI-6

ESTIMATED 1980 PEAK HOUR VEHICLE ARRIVALS*
ALEWIFE STATION

	Mode of Access			
Access Route (D) and Alternative Terminus	Park-and-Ride	Kiss-and-Ride	Auto	Bus
Alewife Brook Parkway (N)				
Route 128	370	100	470	6
Arlington Heights	400	100	500	6
Alewife	440	180	620	12
Alewife Brook Parkway (S)				
Route 128	50	50	100	7
Arlington Heights	50	50	100	7
Alewife	60	70	130	7
Route 2 (W)				
Route 128	570	210	780	8
Arlington Heights	810	210	1,020	8
Alewife	840	300	1,140	21

(D) - Denotes direction from which arrivals originate, i.e.,
(N) = from the North

* Source: CTPS

Table VI-7 shows the estimated number of feeder buses required to satisfy the expected peak-period demands at Alewife Station with the Red Line Extension to Arlington Heights. Also shown is the 1977 existing bus supply and proposed bus supply strategy developed in response to the Red Line Extension. In addition to feeder bus service to and from the Alewife Station, shuttle bus service from the station to the "industrial quadrangle", the Fresh Pond Shopping Center, and other local destinations might be initiated as warranted.

Table VI-7

ESTIMATED 1980 PEAK-PERIOD FEEDER BUS REQUIREMENTS AND SUPPLY STRATEGY*
ALEWIFE STATION

Peak Period Bus Requirements

Approach Direction	Existing 1977	Proposed
East		4
West	4	4
TOTAL	4	8

Peak Period Bus Arrivals

Access Route	Existing	Proposed
Route 2W	4	8
Alewife Brook Parkway N.	4	12
TOTAL	8	20

Source: MBTA

The Alewife Station would function principally as an auto intercept point with terminals at either Route 128 or Arlington Heights. Existing bus supply in the Alewife area is only slightly less than that required for termini at either Route 128 and Arlington Heights. However, if Alewife is the terminus, the Alewife Station would have to accommodate a significant number of bus arrivals in addition to the anticipated large volume of auto arrivals. An Alewife terminal would double the number of buses required to meet peak-hour demands.

The Alewife Station would be a major transit stop, regardless of where the Extension ultimately ends. Its prime location--near land available for development and at the intersection of two major highways--is well suited for a major intercept transit station, except for the traffic congestion problem created by the termination of Route 2 at its juncture with the Alewife Brook Parkway, as previously noted. Modifications to the intersection of Route 2 and Alewife Brook Parkway and provisions for direct access to the garage from Route 2 would help to alleviate the traffic congestion. Preliminary design plans have reflected this location by including facilities to handle large numbers of passengers and significant volumes of park-and-ride, kiss-and-ride, and bus arrivals. Sufficient space would be provided to accommodate 20 to 21 buses and between 60 and 150 kiss-and-ride vehicles at any one time. The Alewife station and garage is planned to operate with access from the area's existing streets; however, the MBTA is also prepared for direct access from Route 2 in the event that the MDPW implements its plans.

Impacts

A transit station at Alewife would afford direct access to downtown Boston and Cambridge; serve as a major transfer point for inbound travelers; and, due to the major highway access, extend transit service--including additional local bus service--to much of the Northwest Subregion.

If the Red Line is extended to Route 128, it is anticipated that approximately 1,300 vehicles (bus, kiss-and-ride, and park-and-ride) would have to be accommodated at the Alewife Station during peak-hours; an extension to Arlington Heights would divert an additional 300 vehicles to the Alewife Station. If Alewife is the terminus, approximately 2,000 vehicles would be expected at the station during peak hours.

Based on CTPS estimates, parking requirements at Alewife would vary with alternative Red Line termini as shown in Table VI-8. Allowing for parking turnover, and assuming that 2,000 parking spaces would be provided at Alewife, there would still be an excess park-and-ride demand. As a result, it is anticipated that a revaluation of access mode by potential park-and-ride users and an associated diversion to other modes (bus and kiss-and-ride) would occur. The net result of these diversions would be a decrease in the excess daily parking demand. Table V-8 shows estimated 1980 initial excess park-and-ride demand, anticipated diversions to kiss-and-ride and bus modes, and the subsequent revised excess park-and-ride demand at Alewife Station.

If the excess park-and-ride demand is great, and local residential and commercial parking spaces become attractive as parking spaces for transit users, a parking sticker program could be implemented. Such a program, however, would mean an additional policing cost to the City of Cambridge and to the Town of Arlington.

Table VI-8

1980 PARK-AND-RIDE EXCESS DEMAND AND DIVERSIONS*
ALEWIFE STATION
(Vehicles/Day)

Terminus Alternative	Park-and-Ride Demand	Initial Excess Demand	Expected Diversions to: K-R	Bus	Total	Revised Excess Demand
Route 128	2,500	350	140	140	280	70
Arlington Heights	3,000	900	190	100	290	610
Alewife	5,100	3,000	470	310	780	2,220

*Source: CTPS

With an extension of the Red Line to Route 128, the excess park-and-ride demand would be 100 vehicles per day; however, there would be temporary peak hour parking surplus, allowing approximately 500 vehicles per peak hour to divert to Alewife from other stations where parking demands may be greater than the supply. Parking at Alewife would not reach capacity until after the peak period; and therefore, the Alewife Station could accommodate some of the off-peak excess park-and-ride demand.

If the Red Line is extended to Arlington Heights, the Alewife Station would be able to accommodate the peak-hour park-and-ride demand; however, parking capacity would be reached before the end of the morning peak period. With an Alewife terminus, parking capacity at the station would be reached before 9:00 a.m. and not all of the persons arriving during the peak-hour (7:30-8:30 a.m.) could be accommodated. Even if parking spaces are not available at the Alewife Station, some persons may still elect to drive to Alewife and search for on-street parking, further contributing to traffic congestion on local streets in the station area; some persons may be sufficiently discouraged by the limited parking to not use the Red Line, thereby reducing the potential benefit of the proposed extension.

Impacts associated with this alternate vehicular access to the garage include:

- All traffic must go through Rindge Avenue - Alewife Brook intersection. This intersection has a traffic Level of Service F in 1975, 1980, 1985, 2000.

- A.M. Peak - free right hand turn from Alewife Brook Parkway North and Route 2; signalized left hand turn from Alewife Brook Parkway South. Intersection should work.

- P.M. Peak - outbound traffic both north and south must use available "green time" at intersection.

During the construction period, traffic would probably be disrupted on Route 2 and the Alewife Brook Parkway. The alignment would essentially traverse the two highways and the area lacks suitable detour routes to accommodate the large vehicular volumes. A temporary detour roadway on embankment will accommodate the Alewife Brook Parkway traffic. It is expected that some motorists would voluntarily divert to other routes to avoid the construction area.

The City of Cambridge has retained a traffic consultant, Norman A. Abend, to study traffic impacts on the Alewife Area of the transit station and alternative urban design proposals. Appendix K presents analysis and conclusions drawn by Mr. Abend.

Mitigating Measures

Provision of additional parking spaces--beyond the 2,000 spaces planned--to accommodate the excess park-and-ride demand, could maximize ridership benefits. At the same time, it would minimize the potential for transit patrons to park on streets in the Alewife area and at other stations along the line. Provision of additional off-street parking would also minimize the traffic movements associated with searching for on-street spaces. Alternatively, parking control strategies, if properly enforced, could be implemented to restrict the use of on-street parking spaces by transit patrons.

In addition, it is expected that a portion of the existing and future traffic in the Alewife area would divert to the Red Line at Alewife or at other stations, thereby offsetting some of the increased traffic in the station area.

Due to the lack of streets suitable for detouring the large traffic volumes, the Red Line work will require a temporary bypass of the Alewife Brook Parkway between the Freight Cutoff and Rindge Avenue Extension. A temporary four-lane detour roadway on embankment will accommodate the Alewife Brook Parkway. After construction of this segment of the Red Line under the Parkway, traffic will be restored to its present location. In the event that the MDPW project is built, the transit and highway construction would be planned for completion around the same time. However, the traffic disruptive construction will not take place at the same time. Due to the longer construction period, the major construction for the Red Line will probably be done prior to the start of the MDPW construction. The two projects would be closely coordinated to insure that traffic disruption would be minimized.

LAND USE

The proposed rapid transit station would generate new development in the Alewife area. The availability of relatively inexpensive vacant land and the proximity to regional highway and rail networks make this a prime area for new commercial and industrial development.

The extent and nature of new development would be a function of many variables including general economic conditions, marketplace determinants, local land use controls and policies, availability of land, and the suitability of the land to physically support various forms of development.

Past Development

Historically, development in the Alewife area has not kept pace with development in the surrounding areas. This is largely because the land is not highly suited for development due to its poor soil and susceptibility to flooding.

Prior to the early 1930's, development at Alewife consisted principally of scattered single-family residences and a number of extra active industries which used area clay resources to produce brick and tile products. Only within the last 40 years have economic determinants relating to land use resulted in extensive development. The brickyards which once dominated the area have since been replaced by new, more intensive industrial and commercial land uses. Likewise, the large lot, single-family homes have been replaced by multifamily attached housing units.

Intense development of Alewife first occurred in the 1930's when the Dewey and Almy Chemical Company (now a division of W. R. Grace, Inc.) constructed a chemical manufacturing plant on land east of Alewife Brook Parkway. Around the same time, the Hayes Oil Company, leasing land owned by the American Oil Company, constructed an oil distribution facility on a site west of the Parkway and south of the Freight Cutoff.

In the 1940's, West End Iron Works began operations west of Alewife Brook Parkway along the Fitchburg Main Line. At the same time, A. D. Little, Inc. was developing its research facilities along Route 2, north of Little River. More recently, development has occurred mostly in the area between the Fitchburg Main Line and Concord Avenue, west of Alewife Brook Parkway.

Existing Conditions

Residential

Residential land uses at Alewife consist largely of relatively low-density neighborhoods located north of Route 2 and east of Alewife Brook Parkway (see Figure VI-11). These neighborhoods are characterized by frame construction, two- and three-family dwelling units, most of which were built before 1939. Slightly more than one-half of these units are renter-occupied. Gross residential densities for the East Arlington and North Cambridge neighborhoods are approximately 16 to 20 dwelling units per acre. Higher residential densities exist in the area along the Fitchburg Main Line where the Jefferson Park Apartments and Rindge Towers are located. Combined gross residential densities for these low- and moderate-income housing developments average 60 to 70 dwelling units per acre.

Commercial

For the most part, commercial development at Alewife is concentrated near the major highways passing through Alewife, especially along Alewife Brook Parkway, south of the Dewey and Almy Circle, and along Route 2 adjacent to the A. D. Little, Inc. complex (see Figure VI-11). Most of these commercial establishments are typical of "strip" or highway development, i. e., fast food drive-in restaurants, used and new automobile dealerships, gasoline stations, bowling alleys, and motels. One exception is the Fresh Pond Shopping Center, a medium-sized shopping center, with a gross leasable area of approximately 70,000 square feet. It occupies a site east of Alewife Brook Parkway, north of the Fresh Pond Circle. In addition, there are several small, neighborhood convenience-type stores scattered throughout North Cambridge.

Industrial

Extensive industrial development has occurred throughout Alewife especially in the "industrial triangle", an area bounded by the Fitchburg Freight Cutoff, the Fitchburg Main Line and Alewife Brook Parkway; in the area south of the "industrial triangle", west of Alewife Brook Parkway and north of Concord Avenue; and in the area directly east of the Route 2 - Alewife Brook Parkway intersection along the Freight Cutoff. (See Figure VI-11.)

Industrial uses vary in intensity, ranging from light manufacturing and research operations such as Middlesex Welding, Steward Data Systems Corporation and Crimson Printing to heavier industries like Bethlehem Steel, West End Iron Works, and the Dewey and Almy Chemical Division of W. R. Grace, Inc. Generally, the heavier industries are confined to the "industrial triangle" except for the Dewey and Almy complex, located east of the Route 2 - Alewife Brook Parkway intersection.

A. D. Little, Inc., a large research and design firm and largest employer in the Alewife area, owns one of the largest parcels of undeveloped land in the area adjacent to the Alewife Brook Reservation. W. R. Grace, Inc. owns a large parcel of vacant land situated between Russell Field and Alewife Brook Parkway, south of its facility.

Open Space or Recreation

Major open space areas include the MDC's Alewife Brook Reservation along Little River, Alewife Brook, and Alewife Brook Parkway; the Fresh Pond Reservation and related recreation areas; Russell Field in Cambridge; and Thorndike Playground in Arlington. (See Figure VI-11.)

The MDC's lands which parallel Alewife Brook and Alewife Brook Parkway generally north of Route 2 consist of improved, regularly maintained parkland with emphasis on passive recreation. The Alewife Brook Reservation south of Route 2 is mostly open floodplain land with scattered wooded areas and wetlands.

Fresh Pond Reservation, owned and maintained by the City of Cambridge, includes an 18-hole golf course and Fresh Pond, which is a source of drinking water for Cambridge. At one time, Alewife Brook flowed from Fresh Pond north through the "industrial triangle", but it has since been covered.

Both Russell Field in North Cambridge and Thorndike Playground in East Arlington are active recreational facilities. Russell Field contains a football field, basketball courts, a swimming pool and other minor facilities. Thorndike Playground is smaller, containing only two ball fields and a grassed, open play area.

The Cambridge City Dump has the potential to be developed into a large recreation or open space area. Many proposals have called for the development of an extensive recreation complex on the abandoned dump's 52 acres of open land. Although other types of land uses have been proposed for the site, they would be less practical due to the settling conditions and the problems associated with the release of methane gas from decomposing organic waste buried beneath the surface.

Institutional

The only major institutions in Alewife are the Neville Manor Nursing Home, located south of Concord Avenue next to the Fresh Pond Reservation, and the Sancta Maria Hospital, located north of Concord Avenue near the Belmont/Cambridge line. Both facilities are some distance away from the proposed Alewife Station and transit alignment.

Development Constraints

Physical constraints to future land development in the Alewife area can be grouped into two categories: natural constraints such as poor soil conditions, flooding, and ecologically sensitive areas; and man-made constraints such as highways, railroads and other structures superimposed by man on the natural environment.

Flooding and ecologically sensitive areas are the most critical physical constraints related to proposed new development for the Alewife area. A description of the flooding problems and the implications of building a new transit station in the Alewife area are presented in the Hydrology Section of Chapter II.

Poor soil conditions exist through most of the Alewife area, but the soils are not sufficiently poor to preclude construction. These soils consist primarily of a surface layer of fill upon a deep layer of clay on top of bedrock. Caissons or piles would usually be required for structures higher than one or two stories constructed on these soils.

In addition to the existing highway network, the primary man-made constraints on new development are the numerous railroads which cut through the area. A brief description of each line and its importance is presented below:

The MBTA's Fitchburg Main Line crosses Alewife in an east-west direction and carries an average of 30 trains per day. A major truss bridge for the Alewife Brook Parkway spans the railroad right-of-way.

The MBTA's Lexington Branch leaves the Fitchburg Main Line at approximately the same Alewife Brook Parkway bridge, crosses the area in a northwesterly direction, passes under Route 2, and continues through Arlington and Lexington to Bedford. This line carries only two trains a day; however, it serves seven freight users and connects to Hanscom Field. It is also considered important for National Defense Emergency access. If the Red Line is extended beyond Alewife, it would be necessary to terminate freight and commuter rail service on this branch.

The freight cutoff of the MBTA South Acton Commuter Rail Line extends from the Main Line to the freight yards in Somerville. It crosses the area from the west to northeast and serves W. R. Grace, Inc. and six other industrial users.

There are several other rail freight spurs from the Fitchburg Main Line which serve businesses south of the Main Line and north of Concord Avenue. These businesses include the West End Iron Works, A. O. Wilson Structural Co., Rex Lumber, King Arthur Flour, Cooperative Research Supply, Atlantic Stores and several other businesses. Usage ranges from several cars a day for the large businesses to only one or two cars a week for the smaller firms.

The cumulative effect of these railroad rights-of-way in the Alewife area is to divide it into irregularly shaped parcels of land, many of which are isolated from one another.

Plans

To date, no comprehensive or future land use plans have been officially adopted by Arlington, Cambridge or Belmont for the lands near the proposed Alewife Station; however, Cambridge and Arlington are currently implementing planning programs aimed at identifying land use objectives and goals and developing land use policies at the neighborhood level. Priority would be given to those neighborhoods affected by the project -- East Arlington and North Cambridge.

The MAPC has completed a comprehensive plan for the Boston region. MAPC's planning activities, focusing specifically on Alewife, include participation in the Alewife Task Force, particularly on the Land Use Subcommittee which, under MAPC's leadership, is actively involving local businessmen and residents in the development of a general future Land Use Plan for the area. Currently, the MAPC together with the City of Cambridge and the Town of Arlington, using funds provided by the MBTA, is implementing a Joint Planning Program which will develop further refinements in the Alewife Land Use Plan. Planning efforts such as these, initially in the Alewife Land Use Subcommittee and then under the Joint Planning Program, will promote more orderly development than that which has occurred in the past.

Policies

Cambridge and Arlington have issued general policy statements concerning land use in the Alewife area, specifically in relationship to the proposed location of the transit station and parking facilities. In a resolution passed on April 30, 1973, the Cambridge City Council recommended that a station be located west of Alewife Brook Parkway and north of the Rindge Avenue Extension. The resolution also stated that the new Alewife area road system serving the station be designed to protect existing retail, office and residential areas and to encourage transfer to the Red Line by motorists approaching Boston and Cambridge

from towns west of the Parkway. A paper, distributed by the Arlington Department of Planning Development, entitled "Objectives for East Arlington-Alewife Area," described proposals for "Development of the Mugar property as a planned unit development, acquisition of land and abandoned rights-of-way between Thorndike and Magnolia Playgrounds for recreation and open space access, regulatory use of the wetlands in the area and a linear park along the right-of-way of the Boston and Maine Bedford Branch (now known as the Lexington Branch of the MBTA commuter rail system).

Regarding the development of a park between Thorndike and Magnolia Playgrounds, the Arlington Board of Selectmen opposed Station Location C because it would require the taking of the abandoned Boston and Maine right-of-way adjacent to Thorndike Playground and it would conflict with the Town's plans to expand Thorndike Playground, which require the same right-of-way.

The MAPC has also issued several policy statements relating to future land use for certain parcels of land in the Alewife area, and particularly the Alewife Brook Reservation, which was recommended to remain "open and natural, interspersed with centers for active recreation. The entire landscaping should be given high priority by the Metropolitan District Commission and work on new site plans should be started immediately with the participation of the communities and the Massachusetts Bay Transportation Authority".

Zoning

Legal constraints to new development at Alewife include the existing zoning ordinances, subdivision ordinances, and other special land control ordinances of Arlington, Belmont and Cambridge. Zoning for the Alewife area is largely industrial and commercial at the core, and residential at the perimeter. See Figure VI-1.

Another legal constraint is the 1970 Wetlands Act, which regulates development in certain wetland areas of Arlington and Cambridge. This Act requires that wetlands cannot be altered or built upon without coordination with and receipt of a permit from the local Conservation Commission(s) and/or the State.

A 1951 State Statute, Chapter 491 of the General Laws, as amended by Chapter 441 (1960) and Chapter 618 (1970), limits the

power of the MDC to dispose of approximately 52 acres of the Alewife Brook Reservation. The Statute requires that this land be reserved for eventual use by the MBTA. Such a transfer, however, is subject to further affirmative legislative action. The 1960 and 1970 amendments to the Statute extended the law for two additional ten-year periods. If not extended for a third time in 1980, the law will expire in 1981.

Development Trends

During the past ten years, a number of ideas and plans have been transformed into various development proposals. The current status of these proposals by site is briefly summarized below.

Cambridge Redevelopment Authority Proposal

In a study of this area over a decade ago by A. D. Little, Inc. and the Cambridge Corporation, it was proposed that a 47-acre triangle of land bounded on the east by Alewife Brook Parkway and on the north and south by the Fitchburg Freight Cutoff and the Fitchburg Main Line, respectively, be redeveloped. This would involve multiuse development of air rights over the subway including a 2,000-space parking structure, 4,000 housing units, 2.5 million square feet of office space, and other commercial uses. Based upon this proposal, the Cambridge Redevelopment Authority submitted various applications to the Department of Housing and Urban Development; however, no formal designation was ever given qualifying any part of the Alewife area for new community or urban renewal programs.

New England Gas and Electric/Boston Edison

This site was formerly the Fresh Pond Drive-In Theatre. ABT Associates proposed development of a research center with capacity for 2,000 cars, up to 800,000 square feet of office space, and 400 residential units which was not implemented. The site was purchased by New England Gas and Electric and a high voltage electrical transmission station was constructed for joint use by Boston Edison and Cambridge Electric. This project construction has had some impact on the adjacent area since the transformers emit a low-pitched hum resulting in a noise level of 75 decibels at the property line.

Mugar Site

At one time, the Mugar Group planned to develop this site, north of Route 2 and adjacent to Thorndike Playground, for mixed use, including a two-level, enclosed commercial-retail mall; parking for 4,000 cars; approximately 1,000 housing units; and future potential for office space and a motel. This plan was dropped, however, in favor of a less intensive development of mixed office and commercial uses. The major issue concerning development of the site is access to and from Route 2. The Massachusetts DPW under the proposed Route 2 highway improvements does not provide access to the site.

Cambridge City Dump

An extensive engineering analysis was undertaken to determine the potential for reuse of this area. This study concluded that due to the poor soil conditions and methane gas emissions, short-term intensive development would be highly undesirable. Therefore, the dump will probably be improved as a recreation area. Also, the City of Cambridge has studied the possible relocation of recreation activities at Russell Field to the improved dump site and conversion of the Russell Field site to a new elementary school.

MDC Alewife Reservation

The MDC would like to protect its land holdings along Alewife Brook and to improve both the operational and aesthetic characteristics of the Alewife Brook Parkway; however, it has no definite plans at this time, primarily because the MBTA has a ten-year option through 1980 on most of the Alewife Brook area south of Route 2.

Linear Park

More recently, the Alewife Task Force and its Linear Park Subcommittee have been expanding and refining the Alewife Linear Park concept first proposed by the Mystic River Watershed Association (MRWA) during the BTPR Study. Assuming that the Red Line Extension and improvements to Route 2 at Alewife would afford an opportunity for joint development of lands for open space as well as highway and transit uses, the Alewife Task Force has drawn up a general plan for the Alewife Linear Park.

Fundamental to this linear park proposal is the provision of a continuous open space link between the Charles River and the Mystic River. At Alewife, this would involve connecting the area's major open space and recreation areas--Russell Field, Fresh Pond, Spy Pond, Alewife Brook Reservation and Thorndike Playground-- with open space linkage containing bicycle and pedestrian pathways.

The major concerns of the Alewife Task Force relating to the development of an Alewife linear park include:

- Restoration of the parkway character of Alewife Brook and Fresh Pond Parkways.
- Preservation, improvement and expansion of the natural and park lands in the area.
- Linking these lands to form a continuous open space network for bicycles and pedestrians.

As part of the development of a linear park system, the Linear Park Subcommittee proposed the following design criteria:

- Limit traffic volumes on Alewife Brook Parkway to present levels.
- Reduce the number of curb cuts along the Parkway.
- Increase plantings and landscaped areas.
- Limit "carrying capacities" of highways and open space and recreational facilities, thus maintaining a balance between the linear park and development after 1980.

Impacts

Displacement

Construction of the project from Davis Square to Alewife and on to Arlington Heights would require the taking of approximately 10 to 12 acres of land, the abandonment of MBTA's Lexington Branch and Freight Cutoff right-of-way. This would result in the displacement of 8 businesses and approximately 40 to 50 employees.

These businesses presently occupy the site of the proposed parking garage and are all within the City of Cambridge.

Where the project alignment leaves the Freight Cutoff and turns southwest to pass through Station Location B, approximately two to three acres of the W. R. Grace, Inc. property would be required to accommodate station development. The properties that would be taken for the garage and the west entrance to the station are owned by American Oil Company, Mrs. John W. Powers, The Putnam Management Corporation, and Roger W. Brown, Inc.

Easements

Several permanent and temporary easements would be required for this section. Permanent easements would be required where the alignment crosses public or private lands but does not affect any structures. Limitations of use within these easements by property owners would be defined in the agreements drawn up by the MBTA. Permanent easements would be required where the proposed alignment parallels the Freight Cutoff west of Massachusetts Avenue and crosses the northwest corner of Russell Field. (See Table VI-1)

Temporary or construction easements would be required along the line segment to permit access to construction activities.

Station

Construction of the proposed station and parking facilities would temporarily disrupt traffic on Alewife Brook Parkway. A short by-pass roadway would be constructed on an earth embankment adjacent to the Parkway. The temporary detour will permit uninterrupted traffic flow while a section of the station is constructed.

Construction of the garage and the line segment to Arlington could cause the temporary disruption of freight service to Bethlehem Steel along the Lexington Branch, and to W. R. Grace, Inc. Replacement team tracks for local customers along Freight Cutoff will be in service prior to abandonment of through freight service. MBTA is to select team track sites.

Ventilation and Emergency Shafts

Two ventilation and three emergency shafts would be required for this section. These shafts are incorporated in the tunnel/cut-and-cover construction. Temporary impacts are similar to those of the line segment.

Commercial Activities

Business at two restaurants--Babo's and Joyce Chen--may be temporarily disrupted due to the noise, dust and congestion associated with station construction. Potential impacts to other businesses, except for those being displaced, would be minimal. Construction of the proposed Route 2 and Alewife Brook Parkway improvements would have a greater adverse impact on commercial activities along these two highways than this project.

The long-range effects of the project should benefit commercial activities by providing increased accessibility to the area for a larger buying market.

Future Land Use

Since its establishment, the Alewife Land Use Subcommittee has been working to ultimately produce a future land use plan for Alewife which could be used to: (1) refine preliminary station and garage designs so that these designs relate not only to the existing surroundings, but also to anticipated future land uses, and (2) identify and, wherever possible, quantify the indirect or secondary impacts of the transit improvements which can generally be considered as the impacts on the communities resulting from new development induced by the introduction of the transit system to the area.

In September of 1975, the Land Use Subcommittee's Alewife Land Use Report was distributed to the Task Force members, and the community. It contained a detailed analysis of Alewife land use issues, concerns, and constraints and described in detail--parcel by parcel--future land uses which might occur. Excerpts from that report,pertaining to possible future uses in the major subareas, are presented verbatim below.

REPORT OF THE ALEWIFE TASK FORCE
LAND USE SUBCOMMITTE, SEPT. 1975

1. "TRIANGLE"

The "Triangle" lies between the B& M Main Line, the Freight Cut-off and Alewife Brook Parkway. It is largely developed with heavy industry, with commercial uses near the Parkway.

Currently the only road access to the Triangle is Rindge Avenue Extension, whose intersection with Alewife Brook Parkway is a major bottleneck. Much better access will be needed for the parking garage, and this is being planned. But the total capacity needed for this access depends greatly on the future use of the Triangle and the amount of automobile usage it will generate in employees, customers or residents. This is one of the many "land use inputs" needed for the transportation planning process.

The proposed transit station would have an entrance at the eastern end of the Triangle and the proposed parking garage would also be located on the Triangle. Seven or eight businesses employing 40 to 50 people would be displaced. The Triangle would probably experience the greatest increase in property values of any parcel because of the location of the station and garage. Thus the Triangle will be under heavy pressure for development to "higher" market uses which could generate more rental income per acre.

A development proposal for the Triangle was made in the late sixties by Arthur D. Little, Inc. and the Cambridge Corporation. This proposal envisioned a very high density of residential, office, commercial and parking uses in a "megastructure" of 15 stories. It contained 7.6 million square feet of floor space and structured parking for 8,500 cars. By comparison, the Prudential Center complex contains approximately 4 million square feet of floor space. The proposed development would provide many jobs and dwelling units and a large addition to the Cambridge tax base. The proposal was a conceptual one and its economic and engineering feasibility have not been tested. It would clearly have major implications in road access, traffic generation, visual scale, numbers of people, etc.

Other proposals might be made for the Triangle, including new development at a smaller scale than the ADL proposal, incremental redevelopment of properties within the Triangle, or no change. Because of the market pressures for development which will come with the transportation improvements it is essential to consider the various development possibilities. The design of the parking garage, access roads and ramps and transit stations will set the stage for the future of the Triangle. If the broad outlines of a land use plan can be agreed on, the design of these facilities can help to bring it about.

2. GRACE, NORTH

The portion of the W. R. Grace Co. property north of the Freight Cut-off is similar in many respects to the Triangle. It is heavily developed with industrial buildings, it has inadequate road access, and it will have easy access to the transit station and garage. Six hundred people are employed on the property, mostly in office and research work although some manufacturing is expected to continue on the site for a number of years. (The Task Force has received a letter from the Grace Co. dated July 14, 1975 which outlines the use of the property, some current concerns, and thoughts on future possibilities.) Many people would describe the industrial buildings as an eyesore and incompatible use in a mainly residential neighborhood. The rush hour traffic from the site produces a major bottleneck on Alewife Brook Parkway.

Construction of the transit extension will produce temporary disruption of the Harvey Street access to the site. The major impacts of the extension will be better accessibility for workers and increased property values and market pressures for development. The single ownership of this large site by a firm with world-wide development capabilities enhances its development potential.

No specific proposals have been made for redevelopment of the site, but office and residential uses or a mixture of the two, have been mentioned as possibilities. The concept has also been mentioned of concentrating any dense-development at the western end of the site near the present Dewey and Almy Circle, with low density or green space "buffer" areas toward the residential neighborhoods to the north and east.

The future of the site is less critical to transit station and garage design than the future of the Triangle. But it is crucial to the redesign of the intersection of Route 2 and the Parkway. Better road access is needed for the site at present. The type and scale of access provided will set one type of upper limit on any future development on the site.

Another limit is set by Cambridge's strong opposition to any further subsidized housing in North Cambridge. Housing of any type will be viewed with some suspicion by that neighborhood, which has experienced severe problems with several low and moderate income housing projects in the area.

Redevelopment of the Grace site could yield additional employment and tax base for Cambridge, and remove the industrial image from the neighborhood. It could also add to the effects produced by the transit station on property values, rent levels, development pressures, and neighborhood stability in the surrounding area. These effects will be difficult to predict, but they must be considered in the planning process.

3. GRACE, SOUTH

The southern portion of the Grace property is bounded by the Freight Cut-off on the north, Russell Field and an MDC swimming pool to the east, Rindge Avenue and the Rindge Towers to the south and the Parkway and some business properties to the west. The land is mostly open but contains some industrial buildings at the northern end. Jerry's Pond, at the southern end, is a former claypit which is currently used for industrial cooling by the Grace Co. This use of the pond will be required as long as manufacturing operations continue on the northern Grace site.

It is expected that a 2-3 acre portion of the site would be excavated during construction of the transit station. After construction the site would contain an entrance to the underground station and some road or pathways for pedestrian and bicycle access to it from the surrounding areas. The station platform, running under the Parkway, would form a pedestrian connection between the site and the Triangle. Some of the proposed roadway schemes would elevate the Parkway in this area so that there would be an open "green" connection with the Triangle and the Alewife Brook Reservation.

Discussions of future use of the site have focused on open space and recreation. Because of its location some or all of the site would form an important piece in the Linear Park network, and Jerry's Pond could be a recreational and aesthetic asset as well as a flood retention pond. The Freight Cut-off, separating the two portions of the total Grace property appears likely to remain, in some form, for a number of years.

4. ALEWIFE BROOK RESERVATION

The Alewife Brook Reservation is a large, irregularly shaped parcel bordering Little Pond, Perch Pond, the Little River and Alewife Brook. It is one of the largest natural open space resources in the area. It also contains wild areas not found elsewhere in this urban region. These areas are valuable as an educational and recreational resource. But they contain fragile ecological systems which will be destroyed if it is over-used. Thus the part of the reservation in the vicinity of Perch Pond would lose some of its unique plant and animal life if a road were put through or if the area were developed with bike paths, picnic tables, etc. Bike paths and picnic tables are entirely appropriate, however, for other, less sensitive portions of the Reservation.

The Reservation is also an important flood control resource. Its many acres of unpaved land absorb rainfall and its several ponds provide valuable water storage capacity. Some of the small ponds near the Dewey and Almy Circle might be expanded for greater retention capacity.

The MDC, which owns the Reservation, is planning for its future development and use, and has asked for suggestions from the Task Force. The final configuration of the roadways will be a critical element in these plans.

5. ARTHUR D. LITTLE VACANT LAND

The Arthur D. Little, Inc., vacant land west of the Acorn Park complex lies partly in Belmont and partly in Cambridge. The Belmont portion, west of Acorn Park Road, is physically developable and is zoned for residential use. The eastern, Cambridge portion of the land lies within the floodplain and contains deep peat deposits. Development of this area would be more expensive and have potential environmental impacts. In its current natural state the land is an important de facto addition to the Alewife Brook Reservation, "buffering" sensitive parts of the Reservation from Route 2 and the adjacent commercial and research uses.

The transit station and garage would have little direct effect on the property, which would be a long walking distance away. Some possible roadway alternatives include large access roads running across the site, but these alternatives have not received much support to date.

ADL sees no near term prospects for developing any of the land, but is concerned with maintaining the option. One proposed element of the Linear Park concept is a shifting of Acorn Park Road to the north and east to widen the buffer area next to the Reservation. ADL is concerned about this proposal, in that it could deprive them of access for potential development.

6. MUGAR PROPERTY

The Mugar property lies north of Route 2 in Arlington adjacent to a residential neighborhood to the west and north and Thorndike Street Playground to the east. It has been owned by a developer for a number of years, and attempts to develop a shopping center and other high density uses have not succeeded to date. The land is currently vacant and contains two ecologically significant wetland areas. Part of the property lies within the floodplain.

The site is beyond convenient walking distance from the transit station and garage and would not be directly affected by them. Changes in Route 2 between Lake Street and the Parkway could have critical effects on the property. Some form of direct access to Route 2 is a necessity for any large scale development of the site. Access roads and ramps contained in some of the proposed roadway alternatives would take significant portions of the property.

There is much controversy over the future of this site. It is one of the two sizable vacant sites left in Arlington. The Town of Arlington has zoned it for high density planned unit development, seeking an addition to the tax base. The Town is currently studying impacts and access needs of alternative uses and development intensities for the site. No formal plans from the developer are being considered by the Town at this time.

Some people feel that the land is simply not marketable for such large scale uses. A number of others living in the area feel that these uses would be inappropriate next to a stable residential neighborhood. As with other sites, the automobile usage generated by large scale development would be of great importance, and Arlington has requested an assessment of this factor by Fay, Spofford and Thorndike.

7. FRESH POND SHOPPING CENTER

The Fresh Pond Shopping Center is an important and successful shopping facility serving both local and some regional needs. Many people consider it an eyesore along Alewife Brook Parkway; it is a major contributor, with its curb-cuts, to the Parkway's traffic and safety problems. Several knowledgeable people have stated that it is unlikely that the Shopping Center will either go out of business or be replaced at another site in the foreseeable future.

The Shopping Center is beyond easy walking distance from the transit station location and would probably not gain much business from transit users. It may be affected much more by the roadway improvements. Several of the proposed schemes would do away with the Shopping Center's curb-cuts on Alewife Brook Parkway and provide access by means of a

loop road, perhaps including the existing New Street. Some of the roadway alternatives would also take a strip along the Parkway from the current Shopping Center parking lot.

The impact of the roadway alternatives on the various businesses housed in the Shopping Center has yet to be determined.

There have been no proposals for re-use of the Shopping Center site. Depending on the roadway improvements, changes in the parking layout might be necessary. Aesthetic improvements, such as screening with trees, could benefit both the Parkway and the Shopping Center.

8. CAMBRIDGE DUMP

Use of this site as a dump was discontinued several years ago. The land has been covered with fill, but it will be very expensive to build on for many years due to problems of settling and the methane gas generation. The City of Cambridge plans to use the dump site for active recreation and playing fields and some public facilities. It will therefore be mainly open in character and might form one of the linkages in a linear park system between Alewife and Fresh Pond.

The transit station and roadway improvements will improve access to the site from a wide area, as would pedestrian and bicycle linkages proposed in the Linear Park concept.

9. INDUSTRIAL QUADRANGLE

The so-called industrial quadrangle is a large area between the Triangle and Concord Avenue. It is mainly industrial, but has considerable commercial use along the Concord Avenue and Alewife Brook Parkway side. The area is one of Cambridge's major industrial centers and it provides a large amount of employment.

The transit station would provide improved access for some workers, though not much boost to commercial uses due to the walking distance. The impact on property values would be much less than that at the Triangle due to this distance and the barrier effect of the Fitchburg Main Line. In

some of the roadway alternatives the loop road around the Shopping Center also improves access to a portion of the Quadrangle, and this would benefit some of the commercial uses.

Most observers foresee little major change in the use of the Quadrangle. There are proposals to down-zone a strip of the Quadrangle along Concord Avenue to prevent any further highrise development. The currently poor road access to the site contributes to the area's traffic problems. It is hoped that improved access can be designed in conjunction with the Alewife road improvements.

10. NORTH CAMBRIDGE RESIDENTIAL NEIGHBORHOOD

North Cambridge is a long established neighborhood of mostly 2 and 3 family houses. It has been perhaps the most stable neighborhood in Cambridge for many years. Recently, changes have occurred which have had a deep effect on the neighborhood: three large subsidized housing projects have been built in North Cambridge, the largest amount in any Cambridge neighborhood; families have begun to leave, non-family households (young professionals and students) have increased; property values are fluctuating; social problems have emerged.

Traffic on Rindge Avenue has long been a problem in the area. Rindge Avenue is a residential street but it serves as a link between Massachusetts Avenue in Cambridge and the Alewife area.

The transit station will provide a new access to Boston, Cambridge and other points for residents in the nearby parts of North Cambridge. For this reason it should raise property values and rents somewhat. The roadway improvement will have little direct effect on North Cambridge with the exception of the Rindge Avenue intersection. The neighborhood is vitally concerned that some way be found to reduce traffic on Rindge Avenue, limiting it to use by local residents and businesses.

The current desire of both the neighborhood and the City is to maintain the stability of the neighborhood. The neighborhood is separated from the transit station area by Russell Field and Grace property. If large scale development occurs on the Triangle and particularly on the Grace property, there could be development pressures on the residential neighborhood. There would also presumably be an aesthetic improvement. One question is whether appropriate zoning could protect the neighborhood from unwanted development. The whole subject of impacts on neighborhood stability will require considerably more study and planning.

11. EAST ARLINGTON RESIDENTIAL NEIGHBORHOOD

The East Arlington neighborhood is also a long established, stable area, of mostly 2 family homes. It has not had the social problems of North Cambridge. Portions of it are in or near the floodplain and flooding has long been a serious problem. Traffic on Lake Street is also an increasingly serious problem.

The transit station would improve accessibility somewhat, but most of the area is too far away from the station location. The roadway improvements would have little direct effect, except in the case of some alternatives which would require taking a portion of Thorndike Street Playground.

Indirectly, the roadway changes would have a major impact, if a direct access from Route 2 is provided to the Mugar site. This access is required for any large scale development of the site, which abuts the residential neighborhood and the playground.

The transportation and related improvements will indirectly benefit the neighborhood if they help to bring about solutions to the area's flooding problems. The MBTA is funding a portion of the hydrology study being undertaken by MDC. It is expected that a comprehensive report detailing the existing hydraulic capacity of the defined watershed area be developed including the development of the 100-year flood plain.

12. BELMONT

> Some seventy percent of the Town of Belmont drains into the Alewife Brook Watershed. The Winn Brook area, west of Little Pond, is particularly prone to flooding. The main impact of the Alewife improvements on this area will be in whatever improvements are brought about in the flooding situation; however, vehicular traffic flowing to and from the Alewife area may have serious impacts on Belmont Streets."

Any future development at Alewife will have both positive and negative impacts on the surrounding neighborhoods and communities. These would be secondary impacts, the indirect effects of transit development and associated highway improvements.

Potential positive impacts or benefits from new development at Alewife would include:

- Expansion of shopping opportunities with development of new commercial uses. North Cambridge and East Arlington consumers would benefit from new levels of comparison shopping opportunities, reductions in travel time and resultant cost savings.

- Increased business for existing local retail and service establishments as a result of spinoff activities, i.e., consumers drawn to a large commercial center for primary shopping needs will often stop at local stores for specialty or convenience items or service.

- New employment opportunities for local residents as new development creates a demand for skilled and unskilled workers. Many of the new jobs would be within walking distance of North Cambridge and East Arlington residents.

- New recreational opportunities and improvements to existing recreation facilities resulting from joint development opportunities afforded by transit construction and highway improvements.

- More orderly development resulting from local, State and Federal agency commitments to an extensive land use planning and market feasibility program.

- Increased rents and higher home values for present landlords and home owners. This, however, could be a negative impact when viewed from the perspective of a potential renter or home buyer.

- An increased tax base resulting from an increase in land values and an expansion of capital improvements.

- Improvement of the flooding problem if new developments initiate storm water runoff control programs.

- Improved visual amenities resulting from careful design and property integration of man-made structures with the natural environment. Existing unaesthetic structures could possibly be upgraded or eliminated.

Potential negative impacts that could result from new development would include:

- Reduction of the floodplain due to filling of or construction on the existing floodplain. The floodplain portions (generally those lands below elevation 113) of the Mugar, W. R. Grace, and A. D. Little properties could potentially be affected. This impact could be reduced or eliminated by adopting and enforcing local floodplain ordinances prohibiting or regulating development within the floodplain. As discussed in the ecology section of this chapter, encroachment on the floodplain by the station/garage would be offset by retention pond storage.

- Increased storm water runoff resulting from large areas of impervious surfaces, changes in land contouring, and reductions in the amount and density of natural ground covers. Again, the Mugar property and the undeveloped portions of the A. D. Little and W. R. Grace properties are most susceptible. This impact could be mitigated if local communities adopt regulatory controls--such as those adopted by municipalities in New Jersey, Pennsylvania and Delaware--which require land developers to retain on site any additional storm water runoff created by new development. Measures to curb storm water runoff could include construction of retention and detention ponds, landscaping and new seeding, and recontouring of the land. Development of the station and garage facility will include provisions for storm water retention which will retain all new runoff on site and prevent any decrease in the storm water retention capacity of the Alewife Brook watershed.

- Increased traffic generated by new workers, shoppers and transit users traveling to Alewife. This impact could be reduced by utilizing the 1,000 car expansion capability of the Alewife garage; implementing the improvements to Route 2, Alewife Brook Parkway and Rindge Avenue; improving access to such areas as the W. R. Grace property, Mugar property, and the "industrial triangle"; encouraging local communities to adopt residential parking programs to deter anyone other than local residents from parking on local streets; and initiating restrictive parking policies aimed at encouraging use of public transportation or car pooling.

- Increased rents and housing costs near to the proposed station resulting from the increased demand for housing at Alewife. This impact could be offset through additional residential development to meet market demands or zoning reform to protect residential areas.

- Increased use of recreation and open space facilities due to the increased accessibility of these facilities for a larger population. This would be a positive impact until the facility becomes so overused that negative impacts occur. The potential overcrowding of recreation and open space facilities could be reduced by limiting access to facilities or limiting the facilities themselves. Access could be limited by not providing automobile parking; leaving natural areas in their natural state; and,using water channels to secure sensitive areas.

- Increased levels of public services brought about by the need for more police and fire protection. New family-oriented residential development will require additional classroom spaces if current school enrollments are at capacity.

- Sedimentation and erosion, a short-term impact resulting from earth moving and uncovering activities during construction. This impact can be minimized by implementing erosion control programs,such as construction of erosion control barriers and ponds, mulching bare areas, and cleaning silted areas.

- Adverse visual appearances of new construction can be minimized if new development is scaled to surroundings, designed to be compatible with existing structures and planned as part of a total urban design scheme.

- Neighborhood stability could decline if economic pressures on residential neighborhoods result in increased land values and lead to more dense residential uses or more intensive land use. One possible change could be an increase in the number of students and young professionals making for a younger, more transient population.

- Overflow parking on local streets if the demand for parking exceeds the supply. Most likely to be impacted are Harvey, Thorndike and Magnolia Streets and Rindge Avenue.

- Further decline of older retail centers would probably occur if a large shopping center is built at Alewife. The reverse situation could also occur where the "spin-off" of the economic activity at the large shopping center would increase the viability of the older retail centers.

Joint Development

A Joint Planning Program in the Alewife area to be administered by the MAPC is currently in progress. Under this program, funding and technical assistance can be provided to Cambridge, Arlington, Belmont and Somerville and the regional agencies to enable them to undertake planning studies and a public decision process leading to a plan for the control and/or development of land uses in the station area, along with a proposed program to implement this plan.

The objective of the Joint Planning Program is to minimize the impacts of the transit improvements and to take advantage of the development opportunities through proper land use planning.

The major benefits of transit station joint development are: 1) it enables an area to capitalize on opportunities for improvement created by the development of the transportation facility, and 2) it aids in minimizing any potential negative impacts resulting from this development. From a regional perspective, joint development serves to unify transportation planning and comprehensive land use planning efforts. Benefits to local communities include revitalization of declining business districts and residential neighborhoods as well as planned development in keeping with the character of the surrounding area.

Four options to joint development at the Alewife Station are described below:

1. Design of station garage and connecting ramps. This option would confine the initial project to the station and garage, including related access improvements on the site. Joint development would consist of remedial landscaping and other measures to minimize impact due to station construction. Redevelopment in the adjacent area would occur either through public efforts or private developers.

2. Joint development within the immediate station area. This option would define a generalized station site boundary, and would attempt to maximize developer participation and provide flexibility for future con-

nection to adjacent parcels. Within the station site boundary, four principal opportunities for joint development would exist: 1) landscaping along the edge of the Parkway; 2) extension of the station mezzanine area to permit a connection to adjacent sites; 3) joint development of the remainder of the station site for commercial use; and 4) Utilization of air rights over the garage.

3. Joint development of expanded station area. This option would be similar to the second option but would define a larger area as the station site boundary to integrate joint development with the station operations and parking. Station site development would involve either clearing all property or selective redevelopment. One advantage of the expanded station area is that the station and its related joint development could serve as the nucleus for more general redevelopment in the Alewife area. It would be possible to formulate a joint development program of sufficient scale to make a major change in the character of the area.

4. Station development in the context of a larger planning area. Many previous plans and proposals have suggested that the Alewife area be redeveloped on a more comprehensive basis, integrating improved use of existing open spaces with new development of older commercial and vacant areas, while simultaneously taking advantage of the improved transit access. If such a renewal effort is desired, development of the transit station, utilization of air rights and provision of connections to adjacent areas should be designed within a larger framework. In this case, the station would not be a catalyst to future development, but would instead be an integral part of a larger land use and circulation concept for the area.

The scale of the initial station joint development project may have a significant influence on the future development of the adjacent area. With Option 1, maximum responsibility for joint development would rest with the private sector. Option 4 assumes a comprehensive public or private entity would coordinate redevelopment for the area. Option 3 would enable the MBTA to play a significant role in the future development of the area, without having to be burdened with the responsibility for comprehensive area planning.

Urban Design

Construction of the Alewife Station and garage would have a significant impact on the urban landscape. As part of the station development, the land surface above the platform, east of the Parkway, would be jointly developed as an open space link between the Alewife Brook Reservation and Russell Field. A depressed entry court would be located adjacent to Russell Field, at the station's east entrance. The proposed parking garage at the west entrance of the station would consist of four levels above the ground level, rising to approximately 65' above grade; however, it would not be out of scale with the surrounding structures which for the most part, are large industrial buildings. If Alewife Brook Parkway is elevated between the Fitchburg Freight Cutoff and Main Line, only the top levels of the garage would extend above the Parkway; these adjacent structures would help to scale down the visual presence of the garage for neighborhood residents in the Harvey and Cedar Streets area.

Mitigating Measures

Property Takings

The MBTA would compensate property owners for land takings by retaining two independent assessors to appraise the fair market value of each property and/or structure to be taken, and by providing compensation for breaking long-term leases.

Affected property owners would have the right to appeal the established level of compensation. Receipt of compensation would not prejudice the owner's right to litigate for an adjustment in that level.

MBTA staff would assist businesses in relocating by:

- Giving businesses a minimum of four months notice before being required to vacate.
- Providing advisory services to the project area if economic injury results from project activities.

- Making relocation payments, such as: actual moving expenses, direct loss of property, payment in lieu of moving and related expenses, expenses incurred in searching for a new location, storage costs, and property loss compensation.

- All relocation payments will be made in accordance with the "Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970".

Construction Activities

Temporary construction impacts such as dust, noise and truck traffic could be minimized by:

- Restricting construction-related truck traffic to a private, temporary truck road constructed along the Freight Cutoff with access to Route 2.

- Limiting the type of construction noise permitted during daylight and evening hours.

- Performing maintenance on construction equipment and on noise and emissions control devices.

- Wetting down the construction area and approach roads to reduce dust.

- Returning the site to its original appearance or improving it with additional landscaping upon completion of the project.

Future Land Use

The Joint Planning Program funded by UMTA and administered by the MAPC will help local communities prepare future land use plans for their sections of Davis Square to Alewife. Adoption of future land use plans and implementation of the plans with help to lessen the impact of new development on the surrounding residential neighborhoods and the locally unique Alewife Brook Reservation.

NEIGHBORHOOD AND COMMUNITY FACTORS

Determination and assessment of the project's impact on the neighborhoods through which it passes is of primary concern. Evaluation must consider the project's effect on the character, appearance, and quality of life of the neighborhoods.

Existing Conditions

Neighborhoods

As proposed, the Red Line Extension from Davis Square through Alewife and then to Arlington would pass through two distinct neighborhoods--the North Cambridge Neighborhood in Cambridge and the East Arlington Neighborhood in Arlington. Portions of both neighborhoods are located in the Alewife area.

The North Cambridge Neighborhood is bounded by the Somerville line on the north; Porter Square on the east; the Arlington-Belmont line on the west; and by the MBTA Fitchburg Main Line on the south. North Cambridge contains approximately 480 acres of land in a mixture of residential, commercial and industrial uses. Most of the industrial uses are concentrated in the westernmost part of the neighborhood and are physically separated from the residential sector by the Alewife Brook Parkway. All residential areas are concentrated east of the Parkway and are further divided into subneighborhoods by man-made barriers such as Massachusetts Avenue and the Fitchburg Freight Cutoff; these barriers have not lessened the strong social and community unity which has developed over the years in North Cambridge.

The East Arlington Neighborhood is bounded by the Mystic Valley Parkway on the north; Alewife Brook Parkway on the east; Route 2 on the south; and Spy Pond and Arlington Center on the west. Consisting of approximately 1,100 acres, the East Arlington Neighborhood contains roughly the eastern third of Arlington's land area. Land use within the neighborhood is primarily residential,although there are commercial uses along Massachusetts Avenue and Broadway and recreation and open space uses adjacent to Spy Pond and adjoining the schools. Industrial uses are almost nonexistent.

Major arterials divide the East Arlington Neighborhood into smaller subneighborhoods. One of these smaller areas is located between Broadway and Massachusetts Avenue; another, which would experience the greatest impact from the Red Line Extension, is situated between Massachusetts Avenue and Route 2.

Population

Between 1960 and 1970, the total population of North Cambridge decreased only one percent (from 13,395 to 13,272), but the older areas, especially around Porter Square, are decreasing faster than the citywide rate. Approximately 40 percent of the population in North Cambridge has arrived since 1960.

The median age of persons in North Cambridge is greater than that for the City, although it did decrease between 1960 and 1970. Significant population decreases have occurred in the very young age groups (two to four years) and in the adult group (35 to 44 years). Population of the 0-4 year old age group decreased 35 percent--the largest decrease of any age group. On the other hand, the population of the 15 to 24 year old group, comprised of students and young adults, increased 13 to 20 percent between 1960 and 1970. Between 1950 and 1970, the average family size in North Cambridge decreased by eight percent.

In 1970, approximately 4,500 persons in North Cambridge were within a half-mile walking distance of the proposed Alewife Station; of these, approximately 1,690 persons were under 18 and approximately 600 persons were over 65. More than 50 percent of those living in this half-mile area live in the Rindge Towers and Jefferson Park apartments.

In 1970, approximately 4,600 persons in East Arlington were within a half-mile walking distance of the proposed Alewife Station; however, more of these persons were over 65 (1,178) and fewer were under 18 (766) than in the North Cambridge half-mile segment. Together, approximately 9,000 persons in North Cambridge and East Arlington live within a half-mile of the proposed Alewife Station, of which 500, or 5.5 percent are minority.

Housing/Mobility

In 1970, the total number of households in the North Cambridge Neighborhood was 4,549, an increase of 641 or 16.4 percent since 1960. This resulted from the large increase in the number of nonfamily households, which include single people who are mostly students and young professionals. Nonfamily households increased from 15 to 29 percent of the total households between 1960 and 1970.

Nearly all residences in North Cambridge, except those constructed in the last ten years, are two-or-three family housing units. More than one-half of the housing units were built prior to 1940. Between 1950 and 1970, the number of total housing units increased by 22.5 percent; the number of renters increased by 36.8 percent; and the number of owners decreased by two percent.

In 1970, 1,581 dwelling units in North Cambridge were within a half-mile of the proposed station. Of these, 154 units were in single-family dwellings, and 1,427 units were in multi-family dwellings; 1,177 were renter-occupied units and 404 were owner-occupied units. Of the 1,427 units in multi-family dwellings, 646 were in structures with more than 10 units. The average value of the owner-occupied homes was approximately $19,000. Average monthly rents ranged from $108 to $141.

In 1970, approximately 1,490 dwelling units in East Arlington were within a half-mile of the station. Of these, 690 units were owner-occupied and nearly 800 were renter-occupied. The average value of owner-occupied homes was $26,000.

Together, a total of 3,071 dwelling units in East Arlington and North Cambridge were within a half-mile of the proposed station in 1970. About two-thirds of the dwelling units were renter-occupied; approximately two-thirds of these were located in

North Cambridge. Rindge Towers, which contained 480 dwelling units in 1970, accounted for a large percentage of the renter-occupied units. Since 1970, a third building was completed which contains an additional 240 units.

North Cambridge has a very stable population. In almost 60 percent of the owner-occupied units, the head of the household moved in before 1959. Renter-occupied units, except for Rindge Towers which has a high rate of turnover, are also more stable than normal.

East Arlington also has a stable population. For almost 44 percent of all dwelling units, the head of household moved in prior to 1959.

Income/Employment

In 1970, the median family income in North Cambridge was $9,609, slightly less than that for the City which was $9,815. Of the 5,942 residents of North Cambridge who were in the labor force in 1970, 22 percent were professionals; 36 percent were white collar nonprofessionals; and 42 percent were blue collar workers. Unemployment in the North Cambridge neighborhood was 6.5 percent in 1970, well below the City rate of 8.5%.

Major employers between Davis Square and Alewife include A. D. Little, Inc. (1,200 employees), W. R. Grace, Inc. (500 employees), West End Iron Works (175 employees), Avery and Saul (150 employees), Corrugated Can (146 employees) and Comfort Pillow Company (90 employees). There are nearly 6,000 jobs in the Alewife area, all located within Cambridge, and almost all of which are in small firms with 50 or less employees. This represents slightly less than ten percent of all the City's jobs.

Pedestrian Circulation

There are numerous areas of pedestrian-vehicular conflicts throughout the North Cambridge and East Arlington neighborhoods, particularly along the major thoroughfares--Massachusetts Avenue, Route 2, Concord Avenue and Alewife Brook

Parkway. There are a large number of pedestrian crossings--especially by children and teens--along the segment of Alewife Brook Parkway between Concord Avenue and Massachusetts Avenue. There are only two signalized intersections--at Rindge Avenue and at Massachusetts Avenue--along the segment. Unsafe crossings also existed along Route 2, until a pedestrian bridge was erected across the road connecting East Arlington with the Alewife Brook Reservation. Additional pedestrian-vehicular conflicts occur along Massachusetts Avenue in North Cambridge where commercial activities generate considerable truck and automobile traffic.

Several pedestrian-rail conflicts also exist in the Alewife area. The most hazardous of these is along the Fitchburg Main Line between Rindge Towers and the Fresh Pond Shopping Center. Hundreds of persons cross over the tracks in this area every day to reach the shopping center. A similar problem exists along the Lexington Branch and the Fitchburg Freight Cutoff; on the Lexington Branch, not only do many people cross the tracks, they also walk and bike along it. However, since there are fewer train movements along these two lines than along the Fitchburg Main Line, the problem is less severe.

Less hazardous, but still important, considerations are the numerous unfenced water-filled pits and ponds scattered throughout the area such as Jerry's Pond, Yate's Pond, Blair Pond, Perch Pond and Little Pond. Each year one or two drownings occur in these waters.

Public Facilities

Public service and recreation facilities in the East Arlington and North Cambridge neighborhoods include several schools, parks, playgrounds, playfields and other community oriented facilities.

North Cambridge has two large recreational areas--Rindge Field and Russell Field. Located on the site of Fitzgerald Elementary School, Rindge Field contains approximately 7.5 acres and has facilities for baseball, basketball and other field sports, except football. Russell Field is located between W. R. Grace, Inc. and Rindge Avenue, east of Alewife Brook Parkway. Covering about 9.8 acres, Russell Field is used primarily for interscholastic competition and evening baseball and softball leagues. Facilities include football and baseball fields, a running

track and other playing fields. An MDC swimming pool and shelter are adjacent to Russell Field. A more detailed description of this facility is given in the Parks, Recreation and Historic Resources section of this chapter.

There are two smaller recreation areas in North Cambridge, the Gogswell Playground and the Parkway Totlot, which cover 0.7 and 0.1 acres, respectively.

Recreational facilities in East Arlington include Thorndike Playground and the Magnolia Street Playground. Thorndike Playground has been developed with two baseball fields and small areas of open field. The Magnolia Street Playground has not yet been developed and currently exists as an open field. The Town of Arlington has voted for the acquisition of the abandoned railroad right-of-way and some adjacent wetlands to link the two playgrounds.

Four schools--three elementary and one junior high--are located in East Arlington. The elementary schools--Thompson, Crosby and Hardy--all have recreational facilities and are well within walking distances of dwellings which they serve; however, children who live south of the Lexington Branch and attend the Hardy School must cross over tracks to reach the school.

Another community facility in East Arlington is the Branch Library located near the intersection of Lake Street and Massachusetts Avenue.

Impacts

Neighborhoods

As discussed in the land use section of this chapter, extensive new development is anticipated after the opening of the Alewife Station. The bulk of this new development will occur near to the station where land is zoned for industrial and commercial uses and where vacant and redevelopable land still exists; however, a few of these sites are adjacent to residential neighborhoods

and their development for uses not compatible with residential uses may affect neighborhood character and life within the residential neighborhoods. In particular, development of the Mugar property and redevelopment of the W. R. Grace property--zoned for P.U.D. and heavy industry, respectively--with non-residential or high density residential uses could have an adverse effect on the abutting neighborhoods of East Arlington and North Cambridge if proper open space buffering or transitional land uses are not provided. Possible impacts of uncontrolled development at the Mugar and Grace properties include increased traffic on local streets; a decrease in air quality; increased noise levels; changes in the physical appearance and character of the neighborhood, particularly along the edges; less stable population composition; and most significantly, increased pressure at the station areas to rezone residential areas for more intensive uses.

Positive impacts from new commercial and industrial development at Alewife would mean, in addition to higher land values, greater and more diverse shopping and employment opportunities for neighborhood residents--all of which would be within easy commuting, if not walking, distance. Opportunities for comparison shopping and low transportation costs would result in savings for neighborhood residents.

Station-related impacts, independent of any induced development at the station, could include increased rents due to the attractiveness of the area for transit users; higher volumes of automobile traffic on roads leading to the parking garage; and improved accessibility to regional shopping and employment and recreational opportunities outside of Alewife.

The only significant short-term disruption to the neighborhoods would result from construction activities. There will also be short-term inconveniences during construction of the alignment.

Operation of Red Line service through the North Cambridge and East Arlington neighborhoods would facilitate movement into and out of downtown Boston and Cambridge. It would expand educational, recreational and cultural opportunities by providing residents of one area with access to the opportunities available in another area.

Employment

As stated previously, seven or eight Cambridge businesses, employing approximately 40 to 50 persons, would be displaced as a result of the land takings required for construction of this section of the project. All of these businesses could be easily relocated to new establishments, and the majority of these businesses express a desire to remain within the Alewife or Cambridge area.

Residents of North Cambridge and East Arlington would have greater access to employment opportunities throughout the corridor when the transit extension becomes operational, particularly since the Red Line would permit reverse ridership from Cambridge to Arlington, thereby providing access to the employment opportunities in the Route 128 area in addition to providing easier access to the Boston core.

One short-term effect of the project on employment would be the large number of construction-related jobs available to residents of Cambridge and Arlington.

Land Values/Tax Base

Due to the takings required for construction of the Alewife station and garage, lands and improvements assessed at approximately $327,000--which in 1974 accounted for tax receipts totaling $33,860.87--will be lost to the Cambridge tax base; however, with the opening of the station at Alewife new commercial and industrial uses are expected to locate in the vicinity and, by doing so, should add to Cambridge's tax base. It is also expected that property values will increase following the opening of the station. The amount of increase will be a function of market demand which is partly related to the degree of accessibility to the station. Reevaluation of the properties whose values are increased could also result in additional tax revenues for the City of Cambridge.

Pedestrian Circulation

Construction of the Alewife Station and the Davis Square to Alewife line segment would help reduce the hazards of crossing Alewife Brook Parkway and the Freight Cutoff between Massachusetts Avenue and Davis Square.

Construction of a station spanning the Parkway with entrances on both the east and west side would afford a safe pedestrian crossing beneath the Parkway through the construction of a pedestrian underpass. Likewise, the proposed elimination of the Freight Cutoff between Massachusetts Avenue and Davis Square would permit unobstructed crossing between the two sections of North Cambridge and Somerville presently divided by the railroad tracks.

Circulation along and across the Bedford Branch near Alewife will be facilitated by sidewalks included in the proposed MDPW roadway connector ramps.

Community Facilities

Area community facilities could benefit from the extension of Red Line service in that they would become more accessible to a larger population; however, new growth at Alewife resulting from transit station development could place additional burdens on community facilities, particularly educational facilities, if such growth takes the form of family-oriented residential development. Additional families would mean more school age children who would have to be served by Cambridge and Arlington schools; these increases may or may not generate new classroom needs depending on the existing enrollment levels and school capacities.

Currently, the enrollment in the North Cambridge schools is near capacity. Consequently, any significant increase in residential development would require additional classroom space. In response to this potential problem, North Cambridge has expressed opposition to any new large-scale housing development proposed for that neighborhood.

With respect to fire protection, the elimination of the Freight Cutoff east of Massachusetts Avenue will reduce the need for duplicate firefighting facilities on either side of the tracks.

Parking

If the demand for parking exceeds the supply at the Alewife garage, some commuters will probably park on local streets around the station if local parking regulations of the parking sticker program are not enforced. The 1,000 car expansion capability of the garage provides one means of dealing with this problem if it does occur. The local streets most likely to be utilized include Magnolia, Thorndike and Fairmount Streets in East Arlington, and Rindge Avenue and Clifton and Jackson Streets in North Cambridge.

Significant reductions in the number of transit riders parking on local streets in North Cambridge can be accomplished through expansion and proper enforcement of Cambridge's resident sticker program. Arlington could adopt a similar program to regulate parking on the residential streets of East Arlington.

Mitigating Measures

As previously mentioned, the greatest potential impact to the Alewife neighborhoods would be created by any new growth which occurs after the Red Line Extension becomes operational.

The degree to which new growth will impact surrounding neighborhoods would be a function of the type and scale of new development which in turn, is controlled by local zoning ordinances and Federal and State land use regulations such as the Wetlands Act and Section 4(f) of the 1966 Department of Transportation Act. Currently, most of Alewife is zoned industrial which, under the provisions of Cambridge's Zoning Ordinance, permits development of many intensive and varied land uses. In order to limit the intensity of land uses, and subsequently reduce potential impacts to surrounding neighborhoods, it would be necessary to "down zone" certain land parcels at Alewife.

The firm of David A. Crane & Partners has been preparing an Alewife Urban Design Study for the City of Cambridge. The following pages present a summary of their Phase I Report, dated March 22, 1977.

Summary

Alewife Urban Design Study:
PHASE I REPORT
for the City of Cambridge
by David A. Crane & Partners/
DACP, Inc.
March 22, 1977

This Packet is a compilation of materials from the full Phase I Report. The packet includes this report's Summary section, Illustrative Plans of each of the four alternatives examined and a Summary Evaluation Chart which assesses the impacts of each of the alternatives.

PURPOSE AND ORGANIZATION OF THIS REPORT

This report presents the conclusions of Phase I of the Alewife Urban Design Study, prepared for the City of Cambridge in cooperation with the Massachusetts Bay Transportation Authority (MBTA) and the Metropolitan Area Planning Council (MAPC) by David A. Crane and Partners/DACP, Inc. This study has been undertaken to develop a comprehensive urban design plan for the Alewife area in conformance with locally established goals and objectives and to recommend design principles for planned roadway and transit projects in the area to reinforce the desired long range growth patterns.

Tasks of Phase I included inventory of the Alewife area and development of a realistic range of alternatives for future growth of the area. This report is divided into six parts:

- a Summary of the alternatives analysis and its major conclusions;
- Section I, Introduction reviews the project history, summarizes earlier findings, and details the methodology and general urban design concerns used in developing alternatives;[1]
- Section II, Urban Design Alternatives describes in detail the four representative development alternatives analyzed;
- Section III, Comparative Evaluation summarizes the relative impacts of each alternative and draws preliminary conclusions;
- an Appendix contains the detailed impact assessment of each alternative.

Once a general consensus is reached on a preferred direction for growth, Phase II of this study will further define and develop this preferred plan, will establish guidelines to insure conformance to established development goals and objectives and will suggest strategies for implementing the plan.

THE URBAN DESIGN ALTERNATIVES

Four basic alternatives which represent the range of ways in which the area could grow by 1985 have been developed and analyzed. One assumes unplanned growth, while the other three assume planned growth. One planned scheme looks at constraining growth while the other two examine the effect of encouraging growth em-

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1/ See Inventory Report (January 1977) and Alternatives Report (February 1977) for more details.

phasizing different types of land use. These latter schemes assume conformance to a common set of urban design principles.

The amount of development postulated in each scheme has been based on the range of growth projected for the area by 1985 in the Northwest Corridor Market Study. It is important to note that normal development beyond 1985 to the year 2000 could increase these amounts dramatically. Moreover, it is stressed that the alternatives are illustrative only, and are to be seen as a tool for testing possibilities for the future. Each of these alternatives was evaluated in terms of transportation, economic, environmental and neighborhood impacts.

Alternative One: Unplanned Growth

This alternative examines the effects of continued ad hoc development in the area with the existing level of public control and is a realistic base case to which other alternatives can be compared. This approach assumes new development to 1985 of residential, retail, hotel/motel, office and industrial uses to the amount likely to occur at Alewife if no major public plans or negative economic influences intervene.

In an unplanned situation, it is probable that gains to municipal revenues would be considerable, and there would be a significant amount of net new job creation. However, these gains might be offset by high traffic, environment and neighborhood impacts, because new construction would be susceptible to low standards of development and minimal public control and scrutiny. These impacts would get worse over time as more was developed. A loss of long-range flexibility will also probably occur.

Alternative Two: Residential Emphasis

This planned alternative emphasizes development of a significant quantity of housing for moderate, middle, and upper income families and individuals, particularly those who commute to work in Cambridge or downtown Boston, as well as local university students.

This alternative would attract substantial new transit patronage. The traffic impacts of this scheme are significant, although they would be reduced somewhat due to residential movement characteristics. Net fiscal benefit to Cambridge would be relatively high. In addition, an estimated 1700 net new permanent jobs would be created. New residential uses will place higher burdens on existing services. Neighborhood concerns about new residential use are real, although they could be mitigated by two factors: 1) the major housing is located on the Triangle parcel, buffered from other residential uses and 2) the new residential construction could reduce rising pressure on the existing housing Environmental impacts would be relatively low and an extensive linear park could be realized.

Alternative 3: Diversified/Employme.

This alternative explores the implications of a job-intensive approach to the area, with a relatively dense mixed-use development which would benefit from proximity to the new transit facilities. Because of the relatively high growth, this alternative would require access improvements beyond those currently planned in the area, particularly to the Triangle and to the Mugar property.

This option would have the highest municipal net fiscal benefit and would create the highest number of net permanent jobs (3300 estimated) of all four alternatives. However, it has the greatest risks of traffic and environmental impacts of any of the planned development alternatives. Impacts on local service from this type of development would be less than in Alternative 2. While there might be some adverse neighborhood impacts, new housing construction could potentially relieve some pressure on the existing housing stock.

Alternative 4: Limited Growth

This alternative tests the consequences of minimal new development

by 1985. This alternative implies either that conscious policies are used to limit growth, especially in the residential sector in the Alewife area, or that the economic climate is extremely unfavorable. Due to lack of development, portions of the area might be converted into open space and recreation uses. However, this is not necessarily a corollary assumption.

While this alternative has the least traffic and environmental impacts, it also realizes the lowest municipal net fiscal benefit and least job creation of any of the four examined. Low growth puts the least pressure on neighborhood services; however, the absence of new housing development might produce significant pressure on the existing housing by people who commute to Cambridge and Boston-based jobs accessible to the Red Line. This could have a positive effect on property values, but an adverse effect on the stability of the neighborhoods, as new occupants rent or buy from long-term residents.

CONCLUSIONS

A number of conclusions can be drawn concerning the degree to which each of these representive alternative approaches respond to local goals, objectives and concerns. An approach that encourages growth will generate transit patronage, municipal fiscal benefits and employment opportunities at the expense of traffic and environmental impacts. A limited growth strategy would have a neutral effect; it has few negative impacts, but does not contribute significantly to other local goals and objectives. Neighborhood impacts are difficult to evaluate because they are so dependent on specific design, location, and zoning policies which regulate development. It is our opinion that any of the planned alternatives to 1985 could be implemented with minimal local impact, if they are carefully controlled and designed.

Major findings are summarized below:

1. *Planned growth is preferable to unplanned growth in meeting local goals, objectives, and concerns;*
2. *Unplanned growth will result in low quality development and will have a high negative overall impact on the existing area;*
3. *Planned growth will require significant public initiatives to implement any plan;*
4. *Limited growth will not insure that the neighborhood will remain undisturbed;*
5. *The limited growth alternative does not achieve the goals and objectives of the Alewife Task Force;*
6. *The impacts of new development will be significantly different for residential and non-residential uses;*
7. *Comprehensive new zoning controls will be needed to achieve the Alewife Task Force goals and objectives while minimizing neighborhood impacts;*
8. *The preferred plan will most likely incorporate aspects of the four alternatives presented in this report.*

NEXT STEPS

The work to date has established a framework for decision making concerning the future growth and development of the Alewife area. It represents a continuation of a step-by-step process which is now underway for transportation and land use planning at Alewife. The next steps in this process are as follows:

1. Review and discuss this Phase I analysis by individual citizens, public officials and other interest groups.
2. Develop a preferred approach to future growth in the Alewife area.
3. Further define and develop the preferred plan, establish guidelines and suggest strategies for implementing the plan in Phase II of this study.
4. Initiate public actions required to implement the plan.

Figure 15

UNPLANNED GROWTH

ILLUSTRATIVE ISOMETRIC

Figure 18
RESIDENTIAL EMPHASIS

ILLUSTRATIVE ISOMETRIC

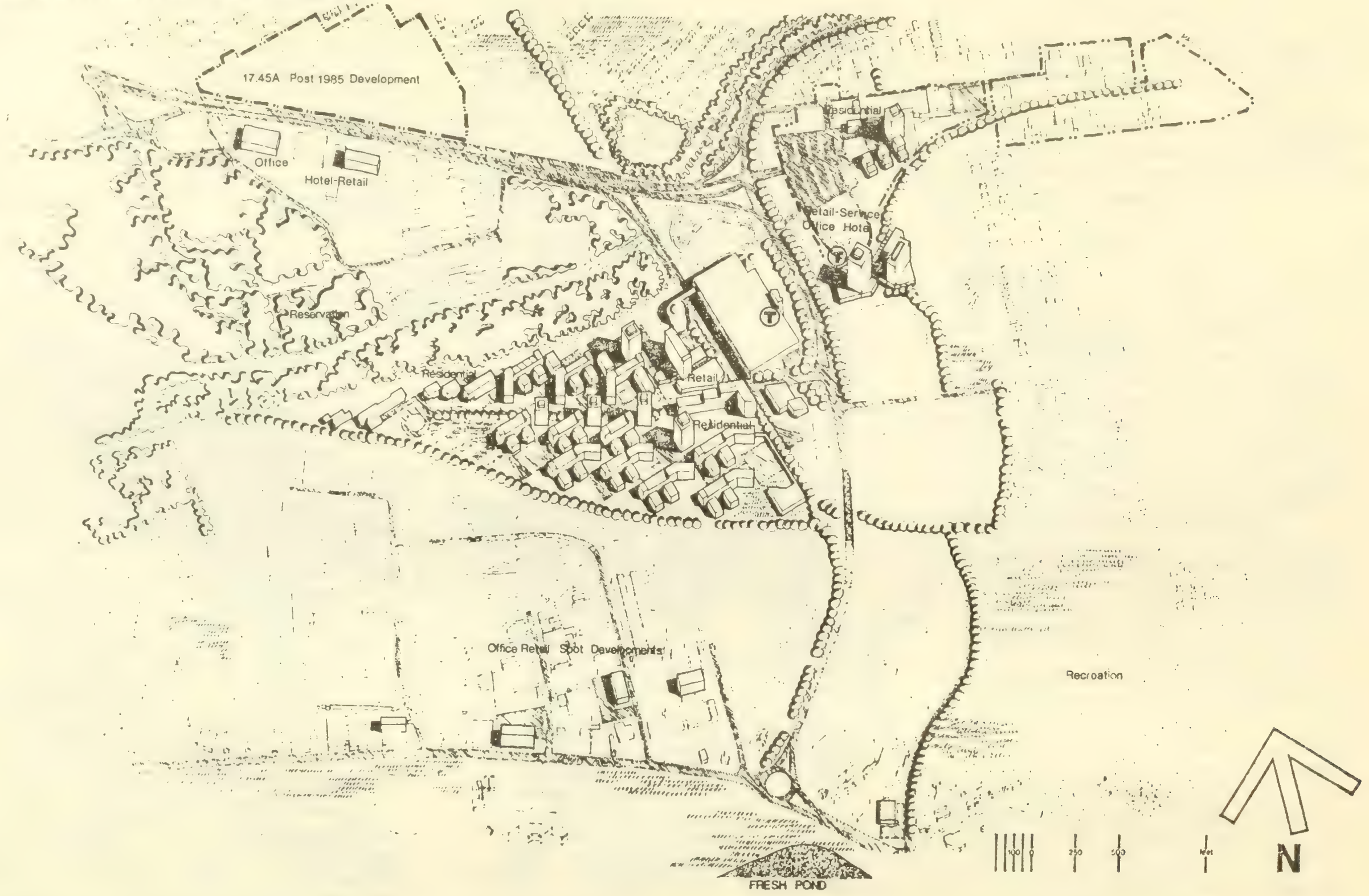


Figure 21
DIVERSIFIED/EMPLOYMENT

ILLUSTRATIVE ISOMETRIC

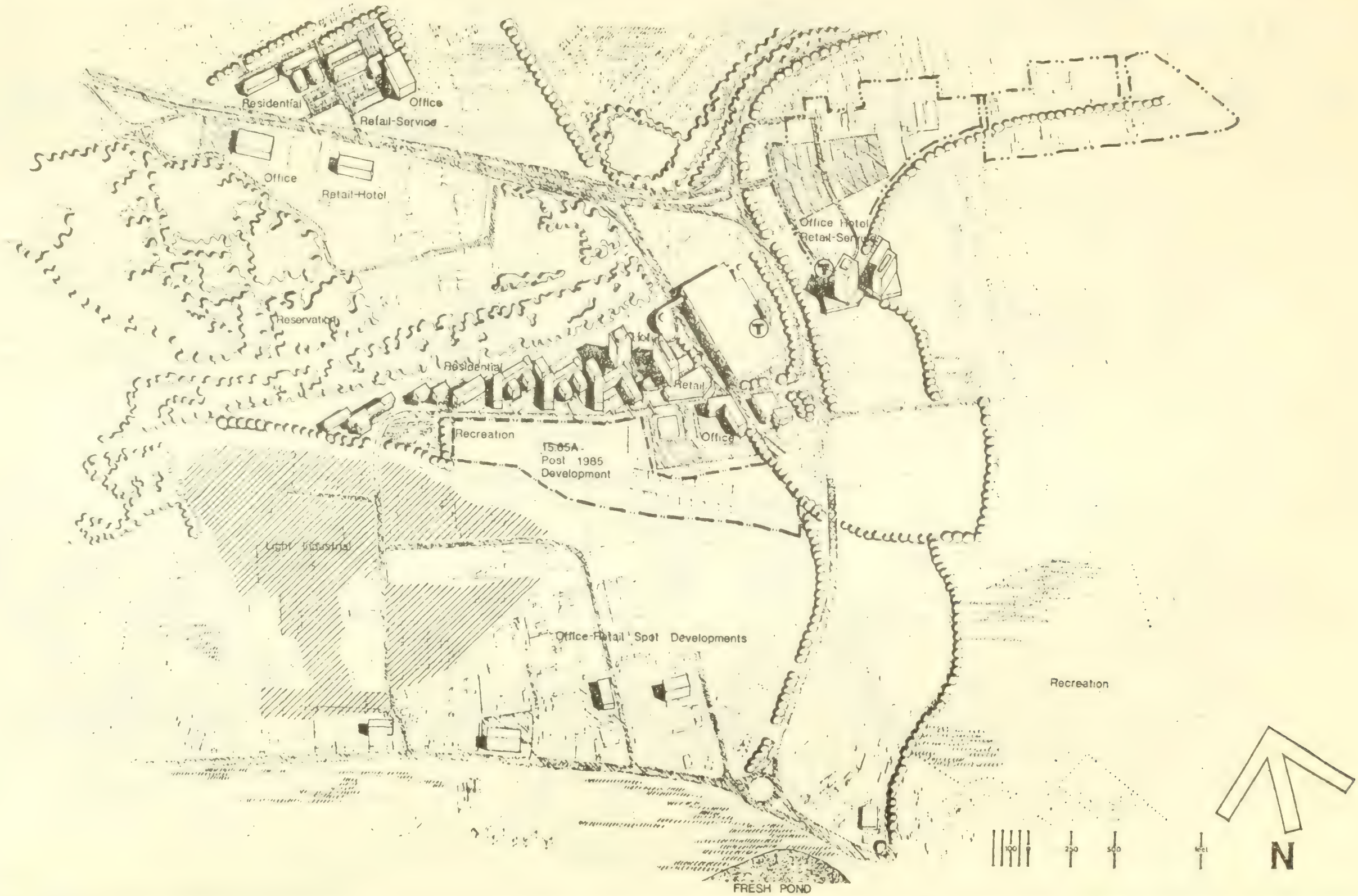


Figure 24
LIMITED GROWTH

ILLUSTRATIVE ISOMETRIC

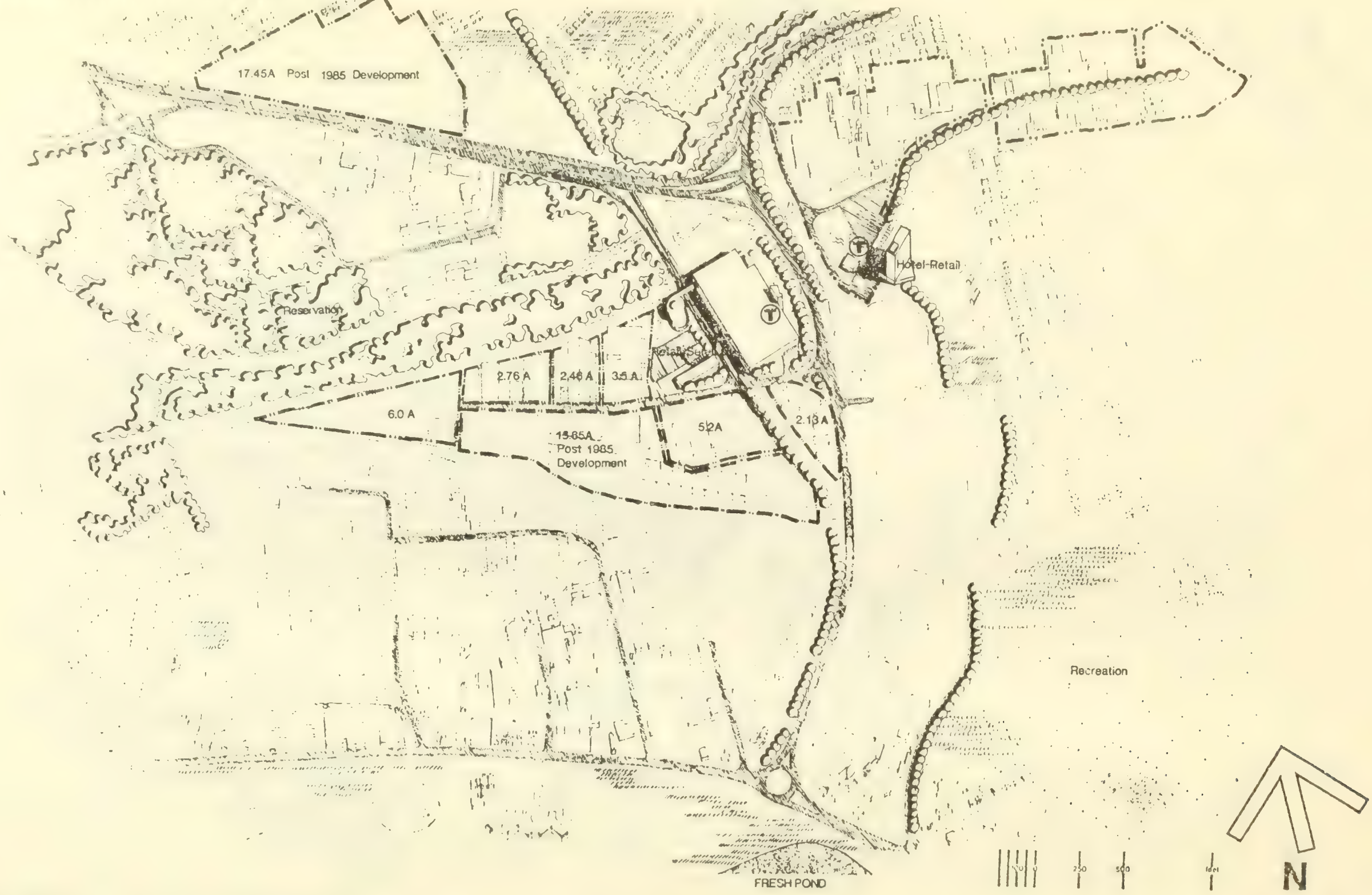


Figure 25:
SUMMARY EVALUATION OF ALTERNATIVES

	TRANSPORTATION					ECONOMIC	
	TRANSIT	TRAFFIC			PARKING	FISCAL	EMPLOYMENT
		GRACE ADT	TRIANGLE ADT	TOTAL ADT			
Alternative 1	o Moderate use of transit	9600	8450	55600	o 3715 parking spaces	o $670,000 net gain to Cambridge o modest benefit to Arlington	o 2200 net new jobs
		o Moderate impact					
Alternative 2	o Highest use of transit	10350	13700	60250	o 3935 parking spaces	o $1,000,000 net gain to Cambridge o Moderate loss to Arlington	o 1700 net new jobs o Highest displacement of existing jobs
		o Moderate impact (impact lessened by reverse communting traffic pattern, generated by residential, at peak hours).					
Alternative 3	o Highest use of transit	9350	10650	64150	o 4955 parking spaces	o $1,350,000 net gain to Cambridge o Highest benefit to Arlington	o 3300 net new jobs o Higher opportunity for blue collar jobs
		o Highest impact (due to high peak hour traffic volumes generated by office/industrial).					
Alternative 4	o Lowest use of transit	4650	2550	34050	o 690 parking spaces	o $160,000 net gain to Cambridge o Moderate loss to Arlington	
		o Least impact.					

SUMMARY EVALUATION OF ALTERNATIVES (continued from preceeding page)

ENVIRONMENTAL				NEIGHBORHOOD		IMPLEMENTATION
HYDROLOGY GEOLOGY	VEGETATION WILDLIFE	AIR/NOISE	OPEN SPACE	N. CAMBRIDGE	E. ARLINGTON	PUBLIC INITIATIVES
o Greatest impact on absorptive area o No control on development in floodplain	o Highest negative impact, especially near Little River	o Moderate impact	o Least enhancement of linear park o Reduces wild area	o Problems with development density, bulk, height, etc. o Minimum control over use o Moderate pressure on existing housing	o Highest impact on adjacent uses o Highest impact on local services o High impact on local streets	o least zoning change o least public action
o Controls assumed for construction in floodplain	o Low impact o New development occurs largely on previously developed land	o Moderate impact	o Most enhancement of linear park	o Depends on zoning controls o Highest impact on neighborhood services o Moderate traffic impacts o Minimizes pressure on housing stock	o Potential new park land	o major zoning changes o substantial public action required
o Controls assumed for construction in floodplain	o Low impact o New development occurs largely on previously developed land	o Moderate impact though greatest of four alternatives	o Most enhancement of linear park	o Depends on zoning controls o Highest potential traffic impact o Moderate impact on neighborhood services	o Depends on zoning controls o Moderate traffic impact o Moderate impact on local services	o major zoning changes o substantial public action required
o Controls assumed for construction in floodplain	o Least impact	o Least impact	o Moderate enhancement of linear park	o Depends on zoning controls o Minimum demand on neighborhood	o Potential new park land	o major down zoning

OPEN SPACE AND HISTORIC RESOURCES

Two open space areas are located along the alignment from Davis Square to Alewife, one of which is public parkland. No significant historical structures are found in the vicinity of this section. The following paragraphs describe the existing conditions for each parkland. Identification of project impacts and mitigating measures for each parkland are included in the Section 4(f) Statement in Chapter II.

Russell Field

Russell Field is a 9.8-acre recreational park in northwest Cambridge, bounded by the Fitchburg Main Line tracks, Clifton Street, Rindge Avenue, and the W. R. Grace, Inc. complex.

Russell Field offers football, baseball, basketball, and unorganized recreational activities for all age groups. The facilities include a football field with bleachers, scoreboard, and goal posts; a quarter-mile cinder track; a baseball diamond; totlot; a small parking area; and a locker room building with showers and dressing rooms.

Access to the field from the north and west is restricted by the railroad tracks and the industrial complex. Access to the east and south is via Harvey, Dudley, Rindge and Clifton Streets. Although a small parking lot is available, pedestrian access is very important.

Rindge Field and St. Peter's Field, located 0.5 mile southeast and 0.75 mile south of Russell Field, respectively, offer similar facilities and activities. The high residential density in Cambridge places considerable pressure on all these recreational facilities and each of the recreational open spaces is highly valuable.

Russell Field was acquired by the City of Cambridge in the early 1900's and has been used for recreation since that time. The field is under the jurisdiction of the Cambridge Recreation Commission which, in a 1972 letter to the BTPR, declared the public park to be of local significance.

Alewife Brook Reservation

The Alewife Brook Reservation can be described in terms of two contiguous areas, for purposes of review and in light of the description of the Reservation land contained in the MDC's April 28, 1977, letter (see page II-180). These areas are:

> Alewife Brook Reservation East. This area includes the Alewife Brook Parkway corridor, which extends from Concord Avenue in Cambridge to the Mystic Valley Parkway in Somerville. It also includes the Yates Pond area, bound by the Parkway, Route 2, and the Boston and Maine Railrod's Bedford Branch and Freight Cutoff; lastly, it includes the area just west of the Bedford Branch, north of the Freight Cutoff, south of Route 2, and generally east of a north-south line which includes the westerly boundary of the ADL parking area. This parking area is leased to ADL by the MDC. As noted in the MDC's letter of April 28, 1977, this portion of the Reservation is characterized by the transportation uses which predominate in this area.
>
> Alewife Brook Reservation West. This area includes the Little Pond, Little River and the associated open-space areas west of the Alewife Brook Reservation East, as described above. This area is generally bound by the Arthur D. Little property on the north, the Freight Cutoff on the south and Belmont residential areas on the southwest and west. It also includes the Belmont Skating Rink, situated within the Route 2/Lake Street interchange.

The total area of the Alewife Brook Reservation (East and West combined) amounts to approximately 124 acres.

Historical Context

The catalyst for the acquisition of the entire Alewife Brook Reservation was a malaria epidemic in the surrounding communities caused by unsanitary conditions in the Alewife marshes. In order to eliminate the malarial breeding grounds, a State Board of Health Report to the Legislature in 1906 recommended the acquisition of these lands. Subsequently, utilizing the so-called Boulevards Act, the Metropolitan Parks Commission (the MDC's Predecessor) acquired the lands from the mouth of the Alewife Brook at the Mystic River to the Little and Spy Ponds in Belmont and Arlington. This was a linear

distance of approximately 2.5 miles. The width of the landtakings varied between approximately 200 and 1000 feet (average width approximately 400 feet) and was governed by the plan of sanitation for the malaria problem. In addition, the land, having been acquired under the Boulevard Act, was to be the site of a "parkway" which would serve to provide a road connection between the Mystic River area to the north and the Fresh Pond-Charles River area to the south. Due to the subsequent redesigns of the roadway, it was built further east on its present alignment. This alignment left undeveloped a parcel of land to the west which remains as open space today.

While the Commission continues to exercise jurisdiction over the Alewife lands, there exists legislation which reserves for the MBTA transit program the bulk of the land in the area which may be affected by the proposed transportation projects. Specifically, Chapter 491 of the Acts of 1951, as amended by Chapter 441 of 1960 and Chapter 618 of 1970, reserve 52 acres of MDC land in the Alewife area for transportation use, subject to further legislative action upon finalization of plans for transportation projects. This reserved area lies west of the Boston and Maine Railroad's Lexington Branch (also known as the Bedford Branch) and runs up to, but does not include, Little Pond.

Alewife Brook Reservation East

The Alewife Brook Parkway corridor itself within the Alewife project area is used for a variety of trip purposes, chief of which are for commuting and shopping and business access to adjacent commercial and industrial development. It is not restricted, like other MDC Parkways, to pleasure vehicles only. Between Concord Avenue and Dewey-Almy Circle, little to no abutting open space exists within the Parkway corridor. Northward from Dewey-Almy Circle, a linear open-space corridor exists, concentrated primarily on the westerly side of the Parkway, and it includes the Alewife Brook.

The remaining portion of the Alewife Brook Reservation East, generally located south of Route 2, between the ADL complex and the Parkway, possesses both developed and open-space uses. The developed uses include the parking area leased by ADL from the MDC and the Boston and Maine Railroad trackage which crisscrosses or bounds the area. The open-space areas between these developed uses have been disturbed in varying degrees by man. Being mostly lowland, reed grass, cattail, sumac, blackberry and red maple are the major forms of vegetation found in this area. Wildlife found there includes the redwing blackbird, starling, swamp sparrow, pheasant, duck, gray squirrel, rabbit, field sparrow and goldfinch.

Unorganized activities such as walking and bicycling have been observed along the Parkway/Alewife Brook corridor north of Dewey-Almy Circle. Some occasional unorganized activities such as walking have also been observed in the Reservation East along the Little River in the vicinity of the ADL parking area.

Alewife Brook Reservation West

This portion of the Reservation is composed primarily of open-space lands, with the skating rink at the westernmost end being the only improved facility located within its limits. Unorganized activities have been observed in this area, including walking, birdwatching and other activities passive in nature. There are no organized acitivities undertaken by the MDC in this area, nor are there any recreational facilities located here, with the single exception of the skating rink. This rink, which is located within the southeast portion of the Route 2/Lake Street interchange, has been inoperable since 1970, and the paved parking area surrounding the rink is used as a "park-and-ride" facility for MBTA buses running to and from Cambridge.

Access to the Reservation West's open-space lands is limited, as there are no official roads entering the Reservation. Access is gained generally by foot, through private property, including the Arthur D. Little, Inc. property, along the Boston and Maine Railroad's right-of-way, or by local paths, mostly on private property, in Cambridge or Belmont.

ECOLOGY

The largest tract of natural open space in the study corridor is the land along the Little River, located generally west of the proposed station. The area potentially affected by the Red Line is the roughly triangular tract, bounded by Route 2, the Dewey and Almy Circle, the Freight Cutoff and Little Pond. See Figure VI-11 The natural areas in this tract have diverse plant communities which furnish valuable wildlife habitat; they also provide potential storage capacity for storm water runoff, and, because of their wetlands characteristics and juxtaposition with the urban setting, afford other ecological benefits for the total environment.

Existing Physical Features: Geology and Hydrology

The Alewife area is in the midst of a valley system, buried under the sands and gravels deposited by Pleistocene glaciers. The axis of the valley follows a course under the Aberjona River and Mystic Lakes to Fresh Pond. Unlike the surficial geology in the rest of the buried valley, which contains thick, highly permeable deposits, the Alewife area is largely characterized by a relatively thin layer of sandy soil underlain by a thick layer of impermeable clay. Sedimentary bedrock is found at depths varying from 140 feet to surface outcrops on the perimeter of the area. A thick (40-60 foot) layer of organic peat is found north of the Little River in the vicinity of the A. D. Little, Inc. development. Sand and gravel deposits, containing some clay, border the area. South and east of the Little River, the lowlands have been filled with extraneous clays, sands, building rubble or other artificial materials.

These surficial deposits have a limited ability to absorb water and transmit groundwater. Fill materials which have been dumped over the lowlands may have compressed the deposits, further reducing their permeability so that groundwater moves even less freely. Due to the clay barrier and compacted deposits, groundwater remains close to the ground surface.

The lowlying Alewife area is poorly drained; this is characteristic of glaciated regions which have ill-defined surface drainage systems. Much of the area surrounding Alewife was originally swampy lowlands but urban development has resulted in a rechanneled, culverted, or otherwise modified drainage system. Alewife Brook, which flows northward into the Mystic River, is the main feature of the drainage system. Spy Pond, Little Pond, Clay Pit Pond, and Blair Pond are impoundments connected to the brook. The watershed drained by this sytem is approximately 5,300 acres including parts of Watertown, Belmont, Arlington and Cambridge.

The wetlands along Little River have also been modified by man. Many small drainage ditches criss-cross the marshes on both sides of the river. These are part of a mosquito control program being implemented by the Middlesex County Department of Health.

Localized flooding in the Alewife watershed is a major concern. Although the stream channel modifications have resulted in some improvements in the hydraulic performance, the flooding problem has been aggravated by the high degree of development in the basin. Surface runoff is rapid because of the impermeable

urban surfaces and because there is little vegetation to absorb and retard surface flow. Much of the floodplain has been taken by urban development. Consequently, land that may once have been a temporary catchment basin for excess water is now flooded, often resulting in economic damage.

The flooding problems along upper Alewife Brook are compounded by downstream bridge and culvert constrictions, reduced streambed capacity from sediment accumulation, and the tidal fluctuations on the Mystic River, all of which contribute to minor and/or widespread backups in stream flow. The Earhart Dam, recently equipped with a special pumping system, has been designed to maintain the level of the Mystic River at an elevation of 107 feet (MDC base) thus eliminating backup problems from tidal surges. The Route 2 interchange improvements may improve the drainage pattern by enlarging the narrow culvert under the roadway. The MDC is currently studying the feasibility of dredging sediments from the bottom of lower Alewife Brook.

While these technological improvements should solve certain hydrologic problems, the wetlands in the Alewife area will continue to act as an important retention basin for high flows and storm runoff.

Water quality conditions in Alewife Brook/Little River indicate a high degree of organic pollution. Measurements of certain water quality parameters in samples taken from lower Alewife Brook are summarized in Appendix C.
Designated as Class C waters according to the Massachusetts water quality classification system, Alewife Brook and Little River are suitable for recreational boating and secondary water contact recreation, wildlife and fish habitat, and certain industrial uses. Major water quality problems have been traced to combined sewer overflows in Cambridge and Somerville during periods of heavy rain. Both Cambridge and Somerville are now planning to partially separate their sewer systems which should minimize the overflows that add raw sewage to Alewife Brook. These sewage additions induce extremely high concentrations of coliform bacteria, including fecal coliforms which indicate the possible presence of pathogenic organisms. In addition to this human health hazard, the decomposition of the excessive organic matter by freshwater bacteria causes widespread oxygen depletion in Alewife Brook. Low oxygen concentrations are exacerbated by low discharge rates. Due to the tidal influence of the Mystic River, Alewife Brook is alternately

a free flowing stream and one that is stilled and pondlike. When experiencing pondlike conditions, the brook does not receive adequate aeration from the turbulence of flow. The sewage pollution also increases plant nutrient concentrations which stimulate growths of algae along the stream banks and bottom. Decay of these algal growths demands more oxygen, further depleting the supply available to other aquatic organisms. Oils, deicing salts and other nutrients and contaminants from urban street runoff as well as various pollutants from industrial effluents also enter the brook and degrade water quality. Although reduced water quality is evident throughout the Alewife Brook/Little River system, conditions are most severe below the confluence of the two streams.

The biology of Alewife Brook,under the pollution-stressed environmental conditions, is limited primarily to pollution tolerant organisms. Benthic invertebrates include snails, leeches, tendipedid fly larvae and bloodworms, all commonly found in polluted waters. Fish species normally inhabiting the stream, such as carp, are tolerant of low oxygen levels. Occasionally, some valuable game species occur in the stream. Mats of moribund algae and other sludgelike deposits are often observed floating on the water surface. Waterfowl that use the stream as a resting place are largely unaffected by the polluted conditions. Mallards, black ducks and coots are often observed on the stream surface. Since the Alewife Brook/Little River is part of the MDC parkway and reservation system, the stream is potentially a valuable recreational fishing and boating resource. Stocking programs have been considered in the past but were always rejected because of the pollution levels. Although some local residents presently sport fish along the stream, wider usage would be expected under cleaner water conditions.

Existing Biological Features

The existing plant communities in the Alewife area respond differentially to the groundwater level and soil moisture regimes which are a consequence of the glacial history. These communities are primarily wetland in nature but vary from marshes on hydric (wet) sites to old field forests in drier locations. Although topographic relief is almost imperceptible, slight rises are interspersed with the lowlands,resulting in a complex mosaic of vegetational associations.

Due to State and community concern for the wetlands, primary emphasis was placed on identifying them according to the State and Federal classification systems. However, because of the continual disturbance from man's influence, no single wetlands classification system can be directly applied to the Alewife area.

Wetlands can be broadly defined as those areas of land where water is so abundant that it is the major factor which dictates the nature of plant growth on the site. Massachusetts wetlands legislation recognizes four major classes of freshwater wetlands--wet meadows, marshes, swamps and bogs--which are distinguishable by the plant species present. Other criteria used to identify these classes include the presence, depth and duration of surface water coverage, location and/or flood susceptibility.

The system used herein to classify the Alewife wetlands not only follows the general guidelines of the State legislation, but also incorporates parts of the systems developed by Golet and Larson ("Classification of Freshwater Wetlands in the Glaciated Northeast", Resource Publication 116, Fish and Wildlife Service, 1974) and Shaw and Fredine ("Wetlands of the United States", Circular No. 39, U. S. Fish and Wildlife Service, 1956). Although no attempt was made to intensively describe the plant ecology of the area, the application of these systems involved vegetation mapping on a general scale using aerial photographs; field checks to identify the dominant plant species in each subarea; and evaluation of other pertinent ecological components. Although both classification systems stress the value of maximum wildlife production, particularly waterfowl, they recognize other valuable ecological benefits of wetlands.

Four classes and seven subclasses of freshwater wetlands were identified in the Alewife area. Identification was based primarily on the presence of wetland plant species recognized in Massachusetts legislation; the physiognomy, or life-form, of the dominant plants; and the presence of water or location on the floodplain. In certain instances, no observable wetland plants were present nor was surface water present. However, these areas are included in the wetlands classification because of floodplain location or their integral relationship to the open space. Figure VI-14 illustrates the extent and arrangement of the Alewife wetland classes and subclasses, which are described below.

Marsh

This class applies to emergent vegetational communities existing in standing water throughout the growing season. Although marshes are often classified as shallow or deep, depending on water depth, no field measures were taken to permit such refinements. Most of the marshes in the area, however, are probably shallow, the possible exception being the two-acre cattail marsh in Arlington, northwest of the Route 2 traffic circle. These marshes offer good muskrat habitat and are valuable to waterfowl as resting and feeding places during migrations. Two subclasses were observed:

- Robust Marsh (RM) Robust emergent plant species dominate this subclass. Cattails (Typha) are found in almost pure sands in wet situations and are fringed by reed grass (Phragmites) which grows under slightly drier conditions. Purple loosestrife (Lythrum) is occasionally found. The major locations of these readily identifiable marshes are in Arlington, west of the A. D. Little, Inc. development, and south of the access road to this property. Since the previous year's growth persists, these marshes provide excellent nesting for waterfowl, wading birds, red-winged blackbirds, and other birds as well as winter cover for rabbits and pheasants.

- Narrow-leaved Marsh (NM) This subclass is dominated by bur-reed (Sparganium), bulrushes (Scirpus), and rushes (Juncus). These marshes are limited in distribution to a border around a small, shallow pond south of Perch Pond and to a small pocket between the Boston and Maine railroad tracks and the industrial development. The dominant plants are mainly valuable as food for wildlife.

Wet Meadow

Surface water is not normally present in this wetland class, but because of the high groundwater table, the soils are saturated within a few inches of the surface. Vegetation includes grasses, sedges, rushes and numerous broad-leaved herbaceous plants, occasionally mixed with some shrub forms. Two subclasses are present:

- Herb-grass Wet Meadow These areas are predominantly covered with unidentified grasses (Graminacae) and numerous herb species including goldenrod (Solidago), vervain (Verbena), primrose (Oenothera), thistle (Cirsium), dock (Rumex), and occasionally blue flag (Iris). Many of the species present are considered indicators of disturbance, illustrating the continuing influence of man's activities. Numerous wildlife species find food, cover and nesting areas in these meadows.

- Grass - Shrub Meadow On slight rises or in areas around which small drainage ditches have been dug, some of the meadows have remained relatively dry; this has permitted the establishment of shrub plants, the initial step in plant succession to forest. The herb-grass components are the same as those listed above, but shrubs such as buttonbush (Cephalanthus), willow (Salix), dogwood (Cornus), brambles (Rubus), and currents (Ribes), are sparsely distributed among the grasses. The ecotonal effect of these diverse life-forms make such areas valuable to wildlife.

Seasonally Flooded Flats

These areas have been a problem for the classification system since they have characteristics of both seasonally flooded flats and swamps. These are defined by the presence of standing water through most of the growing season. Massachusetts wetland laws recognize swamps and although many "swamp" plant species are found, other hydrologic factors at Alewife do not coincide with these categories. Seasonally flooded flats occur on extensive river floodplains where flooding to depths of 12 inches or more occurs annually. Although the water usually subsides in summer, the soil remains waterlogged much of the year. In the case of the Alewife floodplain, however, flooding is irregular. The wetland plant communities have been classified as seasonally flooded flats because of the floodplain location and because plant succession has progressed to shrub and wood seres apparently as a function of the soil moisture. A detailed field study of groundwater depths, plant types, density and frequency, and soil conditions may result in redefining these areas as swamps. Three subclasses have been discerned:

- Seasonally Flooded Shrub Flat Bushy shrub vegetation is dominant and includes buttonbush (Cephalanthus), willow (Salix), alder (Alnus), dogwood (Cornus) and Viburnum. In particular, many of the shrub flat areas are composed of pure stands of buttonbush. Unless

standing water is present, these areas are valuable as breeding and feeding habitat for passerine birds and small mammals. A major portion of the southern Little River floodplain is Cephalanthus-dominated shrub flat.

- Seasonally Flooded Wood Flats In certain places, plant succession has progressed to the bottomland wood stage. Many typical swamp species are present, such as elm (Ulmus), red maple (Acer), ash (Fraxinus), and numerous shrubby trees are also present (alder, willow, birch). Other trees present which are not considered wetland species include aspen (Populus), oak (Quercus), cherry (Prunus), and sumac (Rhus). Sumac is a notable dominant plant at Alewife, often forming large, uniform aged stands, particularly on higher ridges. These are included in the wetlands classification because of their close association with the other plant communities. The major wood flats occur adjacent to Little Pond along the Little River and south of the A. D. Little, Inc. east parking lot.

- Seasonally Flooded Sapling Shrub Flats This category forms a discrete, transitional stage between the shrub flat and wood flat communities. It is found in places where young trees are dispersed among the shrubs. Such sapling shrub or shrub-wood flats form ecotonal "edges" between the shrub and wood flats and are found as relatively small areas scattered throughout the wetland area.

Open Water

This class applies to deeper waters associated with wetlands. Although the surface water may be covered with floating vegetation, the open waters at Alewife--Little Pond, Alewife Brook and the other small ponds--are non-vegetated. Submergent plant forms, such as Pondweed (Potamogeton), bladderwort (Utricularia), and water milfoil (Myriophyllum), typically occur in this type of environment. Large clumps of moribund algae are often seen floating down the brook. Open water provides resting and feeding habitat for waterfowl during migration but its value to other terrestrial wildlife is limited.

Three other miscellaneous types of vegetation/ground cover were observed at Alewife and are presented to complete the vegetative description.

Grass-Fill

In some places, fill material has been allowed to revegetate and has been sparsely covered with a heterogenous mixture of grasses, sedges and shrub sprouts. These communities are located on either side of the A. D. Little, Inc. development and in a large area west of the A. D. Little, Inc. access road. Much of this latter area is covered with young shoots of viburnum. These areas are presently of minimal value to wildlife but as they become revegetated, their habitat value will increase.

Burned Areas

Areas that dry out in the fall have occasionally been set afire, apparently through accident or design by youngsters playing in the area. Although this uncontrolled burning is not widespread, it does eliminate the absorptive organic peat which is built up in these areas. Fire, however, retards plant succession by eliminating shrubs and tree saplings and is unknowingly an effective management tool useful in preserving the meadow wetland types. These burns are usually revegetated the following spring and summer with the annual grasses and herbs in the area or with the plant species present before burning if the sod is not severely damaged.

Roadside Vegetation

Along the Route 2 right-of-way and adjacent to the lower part of Alewife Brook are hardy grasses, domesticated, hybrid sedges, and various small shrubs commonly used to stabilize open cuts; their value is mostly esthetic, but they also act as a filtering device for oils and other contaminants that are washed off the highways.

Additional Wetlands Evaluation Criteria

Size, physiographic location, amount of vegetative cover, and other factors are also useful in evaluating the quality of wetlands. These are briefly discussed below.

- Size

The Alewife wetlands total approximately 80 acres--considered medium-sized in comparison to other wetlands in the northeast. However, the wetlands are fragmented because of roads, railroad tracks and buildings. These urban impingements reduce the quality of the wetlands for biological purposes.

- Site

The physiographic location, based on topography and hydrology, is an important ecological factor in wetlands evaluation. Because of their bottomland, floodplain position, the Alewife wetlands are not as susceptible to drought nor is plant succession as rapid as on upland sites. Furthermore, nutrients are generally abundant and readily available for plant growth. The presence of both Little Pond and Little River in association with the wetlands offers valuable open water habitat requirements for various waterfowl activities. However, the influence of the floodplain on this habitat makes it prone to water level fluctuations. Flooding can destroy the nests of waterfowl and marsh birds and can force small mammals from their burrows, making them vulnerable to predation.

- Cover

The proportion and distribution of vegetative cover to open water is important to wildlife considerations. A 50:50 ratio of well interspersed water and plant cover is optimal for marsh bird diversity while a higher ratio of cover is better for brooding waterfowl. The length of water edge is also important. At Alewife, the cover water ratio is well above 75:25 with only moderate interspersion. The water edge along the Little River is lengthy but it is straight and lacks well-developed overhanging, streamside vegetation. Consequently, the water/cover relationship is not well suited for either diversity or productivity.

- Vegetation Interspersion

This wetland characteristic is based on the degree of contact between the subclasses of wetland plants. Generally speaking, the length of edge between two life forms influences the population densities while the various kinds of edges determines the wildlife species diversity. Thus, high wildlife value is associated with a high degree of interspersion. For the total Alewife area, interspersion is low to moderate. Many large, unbroken stands of one life form are found (Typha marsh, for instance) but there is some irregularity in the distribution of life forms. The most valuable area of Alewife wetlands, based on interspersion, is bounded by the A. D. Little, Inc. access road (north), the A. D. Little, Inc. development (east), the Boston and Maine Railroad (south), and Perch Pond (west).

- Surrounding Habitat

The Alewife area is surrounded by urban land. The disturbances from this environment are a major deterrent to breeding wildlife populations although some interior areas may be suitable because they are buffered from the detrimental urban effects. The value of the eastern portion of the wetlands is particularly deteriorated because of the urban encroachments.

- Relation to Other Wetlands

There are numerous urban lakes, ponds and reservoirs, usually surrounded by urban parkland, in the Alewife vicinity along with larger, more diverse wetlands, such as the Great Meadow-Monroe Brook area. These areas offer a diversity of habitats for waterfowl in the Alewife area and are especially valuable during migration periods when large flocks may congregate to rest on large bodies of open water but divide into small groups for flying to various wetland areas to feed.

Summary

The following summarizes the value of the Alewife wetlands for the purpose of maximum biological productivity:

- Dominant vegetation consists of cattail marshes, buttonbush shrub flats, grass meadows and wooded areas of sumac.

- The Alewife wetlands are medium-sized and located on a floodplain, with a minimal interspersion of water. Vegetative interspersion is low to moderate overall, but with more favorable interspersion in one identifiable location.

- The surrounding urban environmental fragments and degrades the wetlands. Interior, buffered regions are less affected by urban influences.

For wildlife considerations, the most valuable area of the Alewife wetlands is generally the Alewife Brook Reservation West. This area contains a great diversity of plant species and life forms; is well buffered from most of the urban setting; and has a more favorable interspersion of both water and vegetation than the remaining portions.

Analysis of the animal populations in the Alewife wetlands area has been limited to an inventory of probable birds and mammal species in the study corridor, presented in the Appendices to this report. Bird species which have been sighted in the Alewife area have been indicated by asterisks. Birds commonly seen in the wetlands area include mallard, black duck, pheasant, herring gull, blue jay, chickadee, catbird, various warblers, red-winged blackbird, grackle and various sparrows. Common mammals include muskrat, mink, raccoon, cottontail rabbit, skunk and a number of small rodents.

No threatened wildlife species, based on the U. S. Department of Interior's Threatened Wildlife in the United States, occur in any part of the Alewife area. None of the birds or mammals found in this area are listed as rare or endangered in Massachusetts

according to the Massachusetts Audubon Society. Certain wetland plant species on the list may occur in the more favorable, undisturbed portions of the Alewife wetlands. The Alewife wetlands may also provide suitable habitat for other animals on the list (the southern bog lemming, for instance), but the presence of such animals has not been reported. Due to the disturbed, urban surroundings, such sensitive animals were probably extirpated from the area long ago.

Other Ecological Functions

The Alewife wetlands perform other important ecological functions along with biological productivity. One of the most significant roles is that of pollution filtration. Wetlands are able to remove pollutants from waters passing through them, resulting in reduced biological oxygen demand, higher dissolved oxygen levels, lower temperatures, and reduced sediments. Since much of Alewife's wetlands are flooded irregularly, this beneficial function is normally limited to, and most important near, the marshes and drainage ditches west of A. D. Little, Inc. development and in Alewife Brook above the confluence with the Little River.

As a by-product of photosynthesis, the green plants release oxygen to the atmosphere. Although the moderate size of the wetlands limits the amount produced, the value of this oxygen should not be underestimated, particularly because of the proximity of the highways.

The wetlands in the Alewife Reservation West are a valuable educational resource in the urban setting. The significance of the educational potential in this urban location could increase due to rising fuel prices and transit access.

The principal ecological service provided by the Alewife wetlands for the surrounding communities is flood control. The wetlands are an important part of the hydrologic regime; they retain excess water, lower flood crests, minimize erosion, and reduce flood destructiveness. Urbanization of the region has contributed to rapid runoff rates and floodplain encroachments have

aggravated the flooding problems in the vicinity of the wetlands. Consequently, all of the wetlands are essential to this ecological function.

Impacts

Construction of the project would have both short- and long-term adverse impacts and some long-term positive impacts on the ecology of the Alewife wetlands. The project would affect the biological and physical components of the wetlands ecosystem as well as certain ecosystem functions. However, since direct impacts would only be associated with the station location and tunnel/cut-and-cover, the major disturbance would be limited to a small area along the eastern edge of the wetlands south of the Freight Cutoff. This area has the least value in terms of the overall ecological functions of the wetlands.

Station Location

Construction activities in the station area would displace some vegetation and wildlife and contribute to runoff problems which could subsequently lower water quality. Although some land below the 100-year flood elevation would be affected on both sides of Alewife Brook Parkway, any reduction in flood storage capacity would be fully offset by a retention pond to be constructed west of the Parkway.

Ecology

The project would eliminate approximately 0.2 acres of wetland vegetation along a drainage ditch south of the MBTA Freight Cutoff and one acre of successional growth on the proposed station site, along with the wildlife habitat provided by this vegetation. The 0.2-acre portion of wetlands--predominantly a wet meadow type--is classified as wetlands because of soil moisture. The wetland plant community has been highly modified by urban activities and its ecological value has diminished. The secondary growth is mostly weed species but there are also several large cottonwood trees. Although these vegetational elements provide nesting and cover habitat for songbirds and for some small mammals, their main value is as a food supply. Loss of the vegetation and wildlife would not significantly alter the diversity of the wetlands species since similar habitats elsewhere in the wetlands would continue to provide reproductive, resting, and feeding requirements for wildlife species now present. However, populations of these species may be depressed because of loss of habitat.

The drainage ditch presently transmits urban stormwater runoff and other effluents to Alewife Brook. As water passes through the hydric plants growing in the ditch, toxic compounds, nutrients and suspended materials are removed from the water. Although the pollution filtration effect of the wetlands is impaired because of urban disturbance, the elimination of the wetland plant "filter" and culverting of the drainage ditch may cause a slight deterioration of water quality since any pollutants in the runoff would enter Alewife Brook directly. No significant increase in water pollutants is anticipated from the station area. Other water quality problems may be experienced on a short-term basis during station construction. Due to the low lying position and high water table, excavation areas would probably need to be dewatered. This process may contribute some silt to Alewife Brook. However, most sediments could be eliminated by use of temporary settling basins. Silt potentially generated by erosion of exposed soils could be controlled by other erosion prevention techniques.

Hydrology

Chapter II discusses the hydrology of the Alewife Area. The following text is taken in part from the Criteria Report prepared by WFEM for the Alewife Station Garage Site: 1e: Hydrology.

Site Area Drainage

The Alewife garage site is bounded by the Alewife Brook Parkway, the Fitchburg R.R. cutoff, the MBTA Commuter Railroad, Lexington Branch, and Rindge Avenue Extension. The Alewife Station portion of the project extends east into the Jerry's Pond area.

There are two possible drainage paths by which runoff can leave the site. Runoff along the Alewife Brook Parkway and Rindge Avenue Extension enters the 48" Rindge Avenue combined sewer. A flow divider located near the MBTA commuter line tracks on the western border of the site allows normal, dry weather flows to enter the MDC sewer system, but possibly discharges stormwater runoff into a ditch in the northwest corner of the project site. Runoff from the remainder of the site is not collected by subsurface drains but moves as surface flow into a ditch along the Fitchburg R.R. cutoff on the northern border of the site. Both this surface flow and any overflows from the Rindge Avenue combined sewer leave the site through a 36" culvert discharging into the Yate's Pond area.

The site area surface features can be divided into 2 different land types; impervious parking lot and roofed areas, and pervious gravel and grass areas.

The subsurface conditions of the site are an important factor in determining the rate of runoff from the pervious areas of the site. The site's soil profile, as reported by Goldberg & Zoino, consists of 5 to 8 feet of miscellaneous fill, overlying sands and deep, soft to medium clay. The groundwater table in this area is at a depth of about 6 feet. The combination of a thick underlying clay layer (probably highly impermeable) and a high water table would indicate the potential for low infiltration rates and hence a high percentage of storm runoff even under undeveloped conditions.

Drainage in Adjacent Areas

The area to the east of the garage site, roughly defined by the Fitchburg R.R. cutoff, Alewife Brook Parkway, Rindge Avenue and Clifton Avenue, includes Jerry's Pond as its major hydrologic feature. The pond outlet is a culvert located in the low lying swampy area between Lehigh Metals and W. R. Grace Co. that is to be the location of the Alewife Station.

During severe storm events in which high stages in Alewife Brook reduce the discharge capacity of the Jerry's Pond culvert, high water levels may develop in Jerry's Pond causing flows to by-pass the culvert. In this situation runoff from this area may flow along the Fitchburg R.R. cutoff and into the low-lying area along northern border of the project site.

Another area of potential concern for the project site is the area to the southwest of the site bounded by the Alewife Brook Parkway, Rindge Avenue Extension, MBTA Commuter Rail Line, and the Alewife Brook storm drain. This area can be divided into two subarea types. One type consists of mostly grassy cover in the railroad storage area. This low-lying pervious area drains into the Alewife Brook storm drain either directly or as surface flow along the MBTA commuter line tracks. A second subarea type is the impervious area consisting of roof tops and paved parking lots along Rindge Avenue Extension. Parts of this area drain via the Rindge Avenue Extension storm drain to the Alewife Brook storm drain while the remainder drains into the Rindge Avenue combined sewer. Only the portion of the runoff from the area that drains into the combined sewer is likely to be significant to the drainage of the project site.

Alewife Brook Flooding Situation

Figure VI-14 shows the limits of the Alewife Brook watershed. A watershed area as referred to in this report is that total area which contributes flow (storm runoff or groundwater base flow) to a particular stream. The flood plain of a stream is the area adjacent to the stream that is susceptible to flooding. The 100-year flood plain of the Alewife Brook in the vicinity of the project area as reported by Fay, Spofford and Thorndike, is shown in Figure VI-15. The flood storage area or volume of a flood plain may increase or decrease as the topography of the area is changed. For example, development of land that involves filling low-lying areas will decrease the water storage capacity of that site. The flood storage capacity of the Alewife Brook is critical in reducing the impact of flooding in the surrounding towns. In recent years the Alewife Brook flood storage has been substantially reduced by urbanization.

The overall objective is to minimize the effects of ASG construction on the local environment. Specifically, these goals include:

- protection of the ASG complex from flooding.
- control of site runoff to be equal to or less than existing runoff.
- to maintain flood storage capability of the site.
- control water quality effects of project in a manner consistent with existing regulations.

Rate of Runoff

In order to reduce the impact of changes in runoff patterns in developing areas, a commonly accepted criterion for the design of drainage is to limit the rate of runoff from the developed site to the rate that prevailed before development. This was found to be the criterion for controlling storm water runoff most commonly used by 40 engineering companies in the United States and Canada in a survey carried out by the APWA.

Design Storm

The Alewife project area has a significant potential for flooding due to the combined factors of a water table near the ground surface, and a high degree of development in the Alewife Corridor area. The design storm recommended by the APWA for designing retention facilities is the 100-year rainfall. This standard seems to be appropriate for use in designing the garage complex detention facility.

Flood Plain

The 100-year flood levels reach an elevation of 7.38 (MSL base) according to the Fay, Spofford and Thorndike report. This generally puts the site 1.5 feet above the 100-year flood level (except for the drainage ditch area of the site). This, however, is based on data from Hurricane Diane 1955. The flooding potential of the Alewife Brook may have increased considerably since 1955 as described previously. Therefore, the 100-year flood plain may underestimate the possible flood levels at the site. Consequently, if the elevation of the garage complex is to be chosen using the commonly accepted 100-year flood plain stage as a criterion, then a factor of safety should be provided above this elevation to protect the garage from flooding.

The above conclusion assumes that the existing Alewife Brook does not undergo any considerable alteration. However, if the capacity of the brook is improved by dredging, or if Craddock Dam is removed, then the flood levels at the site may decrease to possibly less than the reported 100-year flood levels.

The Alewife Station Garage Complex will fall under the jurisdiction of the Wetlands Protection Act (Massachusetts G. L. c. 131, s40) which states that any proposed activity altering the land within one hundred feet of any natural water body or its 100-year flood level must comply with the provisions of the Act.

Under Section 404 of the Federal Water Pollution Control Acts Amendments of 1972, an Army Corps of Engineers permit will be required for any alteration of the flood plain.

Site Topography

A primary consideration for designing the site topography is to maintain the flood storage capability of the site, i.e., the volume available in that area for storing flood flows at various elevations. Flood storage is a very sensitive issue for the communities in the vicinity of the project area due to the serious potential for flooding of the Alewife Brook. Any alterations to site

topography east or west of Alewife Brook Parkway will be designed to maintain present flood storage capacity as well as to prevent flooding of on-site facilities, including vent shafts. Flood plain elevations and storage volumes will be computed and checked at each design phase.

Retention Pond and Drainage

A commonly accepted method of controlling runoff from an urban area is to use some type of retention facility. Retention can be accomplished in any of several ways such as a pond, roof top, or underground tanks. The retention facility proposed for the preliminary design of the garage complex is a retention pond.

The easy maintenance and operation of the retention pond is certainly advantageous. The chief disadvantage of the pond is the area in the site that it requires. If the site area constraints cannot tolerate a retention pond then an alternative design could be used.

Water Quality

The best means of minimizing possible water quality impacts of the project involves keeping the storm water and pollutants separated. This could be accomplished in large part by utilizing a non-parking roof as a design feature of the garage structure. Runoff from the roof surface, which would cover a large portion of the total site, would then be free of the pollutants normally associated with automobile parking areas. The site under these conditions would contribute less pollution than existing site does.

If for economic or other reasons it is not feasible to incorporate a covered garage structure in the design, stormwater will collect accumulated pollutants from the large exposed upper parking surface. Although the quantity of these pollutants would be very small when compared to the quantities of similar pollutants from streets and parking areas elsewhere in Cambridge and in Belmont and Arlington, they could if unchecked represent a pollution loading to the Alewife Brook receiving water that exceeds the present pollution loading.

Several measures have been developed to reduce or minimize the quantities of pollutants that would be discharged into the receiving waters from areas such as that in question. Frequent sweeping of the open upper deck could significantly reduce the accumulation of certain pollutants exposed to washoff, but would not eliminate the problem of storm events which occur before scheduled sweeping. Catchbasins with

grease traps in the drainage system should be used to capture heavy sediment, large objects, and accidental spills during dry periods, but these devices do not reduce the concentrations of dissolved substances in the runoff such as de-icing salt or heavy metals.

Tunnel/Cut-and-Cover

Although the alignment selected for this section of the project would have less impact on the wetlands than the other possible alignments, implementation of the project would cause temporary disruption to the wetland biotic communities and result in short-term degradation of water quality.

Ecology

Since most of the tunnel/cut-and-cover construction would be confined to the existing Lexington Branch railroad right-of-way, severe disruption to the adjacent wetland vegetation would be avoided. However, construction of the tunnel requires crossing two streams: Alewife Brook which, at the point of crossing, is a small tributary flowing northward from the West End Iron Works; and the Little River, which comprises the major flow at the point of crossing. To maintain flow during construction, the Little River would have to be diverted from the existing stream channel around the tunnel excavation and then returned to the original streambed after tunnel completion. The smaller flow from Alewife Brook would either be pumped across the excavation or temporarily channeled around the construction area. These techniques would require space outside of the existing railroad right-of-way and would damage the existing wetland communities. Depending on the difficulties, encountered during construction, the temporary use of one to three acres of land beyond the right-of-way may be required. Such use would eliminate, for all practical purposes, the existing vegetation and wildlife habitat. The proximity of Route 2 and the encroachments of the A. D. Little parking lot and the railroad embankments have disrupted the existing wet meadow and only marginal habitat is provided. Songbirds and small mammals which utilize the food resources and vegetative cover would be displaced by the project.

The construction techniques utilized in crossing Alewife Brook and the Little River would alter the existing aquatic habitat. Since these portions of the streams are already polluted, the potential severity of this impact would be reduced. Only pollution tolerant organisms are found here at present. Removal of polluted sediments and reconstitution of the streambed after tunnel completion may improve a portion of the aquatic habitat. Although only a small area of streambed would be dredged, the quality of the bottom sediments to be removed would be analyzed before excavation to determine acceptable methods for handling and disposal of sediments to prevent entry of contaminants into ground or surface waters. Since stream flow would be diverted prior to removal of sediments, no contaminants would be dispersed downstream. The details of construction, sequencing, sediment disposal, and erosion control procedures would be determined during final design of the project. Necessary Federal and State water quality and wetlands permits would be obtained during final design to ensure project conformance with applicable environmental standards. Under Section 404 of the Federal Water Pollution Control Act Amendments of 1972, a Department of the Army Corps of Engineers permit will be required for the discharge of dredged or fill material associated with the relocation of Alewife Brook and Little River. Approvals must also be obtained from the Department of Environmental Quality Engineering.

Another potential short-term negative impact of the project would be siltation below the construction zone in the Alewife Brook Reservation East area. Sediments would potentially enter Alewife Brook from excavation dewatering, other construction processes, and erosion of exposed soils in the construction area. Suspended silt would periodically be carried downstream as far as the Mystic River, causing high turbidity and potentially lower dissolved oxygen concentrations, some sediments would be deposited along the river, particularly where the current is stilled and pools are found. Biologically, the siltation would suffocate many benthic organisms, thus impacting community structures, and inhibit photosynthesis in affected areas. Most fish would avoid those reaches of the stream affected by high turbidity and sport fishing would be generally unproductive. Serious sedimentation would not be continuous throughout the one- to three-year construction period, but would occur during heavy rains or snow melts. After project completion, water quality would return to preconstruction conditions and an aquatic community similar to the one presently found would be reestablished. These impacts which could potentially result from construction activities in the East Reservation Area can be virtually eliminated by controlled construction activities and mitigating measures.

The Authority is committed to a program of controlled construction activities for the purpose of reducing impacts to the East Reservation. The following section on mitigating measures discusses this program in detail.

Hydrology

The major hydrological consideration in the construction of the tunnel/cut-and-cover is the effect on groundwater flows. This is especially true in the Alewife-East Arlington area where groundwater level is high. The residents have expressed concern with the tunnel acting as a dam blocking groundwater flows and displacing a large volume of water. They fear these conditions would cause a general rise in water level and a worsening of basement flooding.

Based on data gathered during the DEIS and the pre-grant engineering phase, the tunnel should not affect groundwater flows nor raise the water levels. If there is groundwater flow, it should not be impeded by the tunnel.

The Environmental Analysis Report for the Red Line Extension was reviewed by the New England Consortium on Environmental Protection for the Massachusetts Executive Office of Environmental Affairs. The following is a direct quote from this report, pages III-36, III-37 and III-38:

> 4. Ground water and subsurface drainage: The major reasons for protecting ground water levels are to avoid settling of structures, cracking in foundations, and dehydrating vegetation. Dewatering must be done very carefully to avoid adverse impacts on adjacent properties. Some special watering of parklands and vegetation may be necessary because of dewatering. Design procedures for cut-and-cover construction should provide for sealing the tunnel excavation. This would maintain ground water levels as near present conditions as possible and avoid a muddy water disposal problem created by water seepage into the tunnel construction area.
>
> In most sections of Arlington, the soil is primarily sand or gravel and would allow for reasonable subsurface drainage flow and the maintenance of water levels. In

Cambridge and Somerville, impermeable clay deposits occur periodically and ground water flows become more significant. The DEIR is very brief on ground water flows, because of the hidden complexity of underground water movements. In order to avoid undesirable side effects, the tunnel should be constructed on a permeable sand/gravel base wherever it must pass through impermeable clay layers. Then there would be the possibility for water seepage flow under the tunnel structure. This seepage would balance the water levels on both sides of the tunnel and prevent the collection of stratified levels of stagnant ground water--especially at Alewife. By providing a permeable gravel base under the tunnel, it would be possible to prevent the tunnel from being a 20-foot high wall restricting ground water flow.

5. Fresh Water Quality and Supply: Although there are no private wells in the Cambridge/Arlington area, some of the ground water in the Fresh Pond/Alewife region is occasionally drained off by the Cambridge Water Department as a secondary water supply source when the Hobbs Brook Reservoir is below capacity.

The DEIR makes no mention of the significance of the ground water supply to the City of Cambridge. Geologically, Fresh Pond is closely tied to the Mystic Basin watershed. Fresh Pond used to flow directly into Alewife Brook (formerly the Menotomy River) with Fresh Pond Meadow on the west side of the Brook and the Great Swamp to the East. Much of this area has been filled in since the seventeenth century, with only Little Pond/Little River and Alewife Brook remaining visible at the surface. Despite this extensive landfilling, the wetlands/ground water relationship remains between Fresh Pond and the Alewife area. The Cambridge Water Department will periodically lower the water level in the Fresh Pond Reservoir over twenty feet through water usage, while shutting off the inlet from the Hobbs Brook Reservoir. The effect is to draw off ground water from previous and existing wetlands areas and provide Cambridge with an alternate supply of drinking water.

Therefore, there should be provisions within the Red Line Extension design to ensure that this occasional flow of groundwater will not be impaired in either quantity or quality. Seepage circulation around the tunnel must be maintained to prevent any development of stagnant groundwater pockets.

The boring program and design efforts will address the concerns of the New England Consortium on Environmental Protection. The design will include provisions to prevent adverse impacts on floodwater storage capacity or groundwater. Flood storage capacity of the Alewife area may be nominally increased by the removal of the existing railroad embankments and the possible removal of an artificial berm west of the embankment.

Secondary Impacts

An important aspect of Red Line Extension planning at Alewife has been the coordination of the project with the concerns of municipal and regional agencies and community organizations. Recreational land use issues, focusing on the MDC Alewife Reservation wetlands, have been addressed by the Alewife Task Force Land Use and Linear Park Subcommittees with participation of the MAPC and the MDC Planning Department. Current proposals which may be implemented in conjunction with the Red Line construction at Alewife specify that the east end of the Alewife wetlands area--bounded by Route 2, the transit station and the A. D. Little parking lot--would undergo extensive landscape treatment to develop an urban park setting. Thus, one of the potential secondary impacts of the project would be the loss of dominant natural features from the east end of the wetlands. The landscaping would esthetically improve the area without destroying the flood control function of this portion of the wetlands.

An additional secondary impact would be the increased recreational and educational potential of the Alewife wetlands due to their improved accessibility resulting from the transit station and the potential connection to the proposed linear park scheme. To preserve the natural character of the most valuable and ecologically sensitive wetland area (located near the geographical center of the wetlands), and to avoid damage from overuse limited pedestrian access is recommended. Development of a nature trail to educate the people about the value of the wetlands and the maintenance of buffer areas with unimproved trails may be useful in this endeavor.

Mitigating Measures

The MDC, with partial funding from the MBTA, is undertaking an Hydrology Study of the Mystic River and tributaries from the newly constructed Amelia Earhart Dam to the Aberjona River Guaging Station in Winchester. It is expected that a comprehensive report, detailing the existing hydraulic capacity of the defined watershed area, be developed including the development of 100-year flood plain. The final report is to recommend to the MDC various methods of flood control with emphasis on the cost effectiveness of each proposed alternative. The study will evaluate the impact of the proposed MBTA station/garage, tunnel/cut-and-cover and associated roadway improvements in the Alewife Brook/Little River area.

The first results from the MDC study are expected in the fall. This data coupled with the ongoing soils exploration program will be utilized to develop the tunnel/cut-and-cover designs from Alewife to Arlington Center. The many concerns expressed by the local residents and the New England Environmental Consortium will be analyzed and incorporated in the design as it applies. The design will incorporate measures to prevent adverse effects from potential changes in groundwater levels during construction and preclude permanent changes in the groundwater flow pattern which are potentially of an adverse nature.

A number of conservative construction techniques would be employed to mitigate short-term impacts. During the actual construction process, sediment basins and traps, temporary culverts, dust control, grade stabilization structures and other erosion control methods would be used to prevent excessive erosion and sitation. Existing vegetation would be preserved to the extent possible and vegetation that would be removed would not be stripped away until necessary. After project completion, slopes would be graded and promptly revegetated, either with sod or a seed mixture held in place by mulch or jute. Specific designs for sediment basins and traps, culverting, and other erosion control techniques would be detailed during the final engineering phases.

Construction of a retention or detention pond on the station site and removal of unnecessary embankments would improve the flood storage capacity of the Alewife area.

Frequent sweeping of exposed paved areas will reduce the runoff of pollutants and debris during storms. Roofing over the upper garage level was explored as a means to mitigate these impacts but found unpromising because of the considerable expense and visual impacts involved.

The ultimate extent of the secondary impacts resulting from the project would be a function of plans and programs implemented by the involved agencies and community organizations. Recommendations have been made to improve the esthetic character and recreational aspects of the area. Such proposals would also provide an opportunity to improve the wildlife habitat of the wetlands and would include:

- Seeding of important wildlife food plants such as wild rice and millet.

- Planting of overhanging riparian vegetation along the Little River.

- Placing waterfowl nesting boxes in secluded parts of the wetlands.

Efforts to improve the wildlife diversity and productivity could be assisted through coordination with the State Department of Natural Resources, the U. S. Fish and Wildlife Service or active environmental conservation groups. Although such a wildlife habitat improvement program would be implemented in areas of the Reservation relatively removed from the transit right-of-way, impetus for implementation is clearly the Red Line Extension. As a consequence, the MBTA would work closely with the MDC and other pertinent agencies in coordinating enhancement efforts, obtaining appropriate expertise and advice, and developing detailed plans to be implemented during or after construction of the transit project.

NOISE AND VIBRATION

Ambient Noise Conditions

For a discussion of noise, see Chapter II and Appendix D.

Since the alignment from Davis Square to Alewife would run in a tunnel along the existing Boston and Maine right-of-way, airborne noise will not be a problem. Noise levels at the surface may even decrease since freight train operations, which produce peak noise levels of 86 to 88 dBA at 50 feet, may be eliminated.

Present noise levels at Russell Field are:

Site No.	Time of Measurement	Sound Level in dBA			
		L_{eq}	L_{10}	L_{50}	L_{90}
8	16:00	58	61	55	55

See Figures II-1A-II-1E for locations of noise measurements.

Based on the measured daytime noise levels and the usual 10 dBA drop-off in noise levels at night, the neighborhoods along this segment fall into the "busy urban residential" area classification of Appendix D. The proposed station area has no sensitive noise receivers in its immediate vicinity; therefore, due to its nature, and because of noise from Route 2, it falls into the "commercial" area classification.

Future Noise from Transit Operations

Line Operations

The only potential problem connected with line operations would be noise from ventilation shafts. This problem can be controlled through proper design.

Station

Feeder buses and cars would cause only slight increases in noise levels at the Alewife Station. In the residential and commercial areas, closest to the station, the major noise would still be due to traffic on Route 2 and Alewife Brook Parkway. At these locations, noise originating from the station would increase the ambient noise by less than one decibel.

Vibration

For a discussion of vibrations, see Chapter II and Appendix D.

Ground vibrations due to transit operations would be similar to those discussed in the Harvard Square section. There is a potential problem of audible sound from train-induced ground vibration in all buildings and homes within 100 feet of the alignment with little danger of structural damage due to these ground vibrations, but an audible rumbling sound with each train passage may be annoying. Any such impacts found along the alignment would only occur in the Alewife Brook Reservation East Area.

Assessment

Absolute Assessment

None of the IRT noise criteria for airborne noise are expected to be exceeded by transit operations along this segment. However, as previously mentioned, noise levels resulting from groundborne vibrations may be a problem at some of the residences adjacent or close to the right-of-way between the Davis Square Station and Russell Field.

Changes in Noise Levels

Outdoor noise levels between Davis Square and Alewife would not be affected by transit operations. Outdoor noise levels in residential areas closest to the Alewife Station (including increased bus and automobile traffic at the station) would not increase more than one decibel.

Noise Control Techniques

Special vibration control trackwork would be provided for all locations where residences are within 100 feet of the proposed alignment.

Vent shafts would be located away from noise sensitive sites and treated for noise reduction.

AIR QUALITY

Areawide air quality impacts and construction impacts were discussed in Chapter II and the following discussion is restricted to localized CO effects in the vicinity of the Alewife Station. The details of the analytical methodology and the results are presented in Chapter III of Appendix H. The analytical method considered the effects of induced traffic at the station in making air quality projections.

The predicted levels of carbon monoxide in the vicinity of the Alewife Station in the 1974 base year, 1980 no-build case, and the three build cases are given in Table VI-9. All 1980 cases show substantially improved air quality over the 1974 levels. The 1980 build cases are slightly higher in most cases than the no-build CO levels. However, even in the worst instance, the one-hour worst case situation, the increase is only 1 ppm, and no violations of federal or state standards are foreseen.

Table VI-9

PREDICTED CARBON MONOXIDE CONCENTRATIONS (PPM)
IN THE IMMEDIATE VICINITY OF THE ALEWIFE STATION

Meteorological Condition	Averaging Period	1974	1980: No Build Case	1980: Build Case Termination at: Route 128	Arlington Heights	Alewife
Worst Case	8 Hours	13.5	6.6	6.8	6.8	6.9
	1 Hour	21.8	10.7	11.1	11.4	11.7
Most Probable	8 Hours	2.1	1.1	1.1	1.1	1.1
	1 Hour	3.3	1.7	1.8	1.8	1.9

CONSTRUCTION IMPACTS

The major adverse impacts of construction would be air and noise pollution, traffic disruptions, maintenance or relocating of utilities, siltation and erosion, effect on existing structures, disposal of excavated materials, spillage, effects on groundwater table and possibility of encountering an underground stream. A discussion of the general construction impacts can be found in Chapter II. The remaining portion of this section discusses specific construction impacts applicable to this segment.

Traffic Disruption

Temporary decking and construction staging would be required where the project alignment passes under Cameron Avenue, Massachusetts Avenue and Cedar Street. In the Alewife Station Area, maintenance of traffic on Alewife Brook Parkway will be of major importance. Timing of this project with the proposed Alewife roadwork will determine construction staging. For further discussion turn to Page VI-32, "Mitigating Measures", and Page VI-29, "Impacts".

Service to freight users will probably be affected during construction. For a discussion, see Pages II-54, VI-2, and VI-10 .

Utilities

There are several utilities that will be relocated or maintained during construction.

Disposal of Excavated Materials

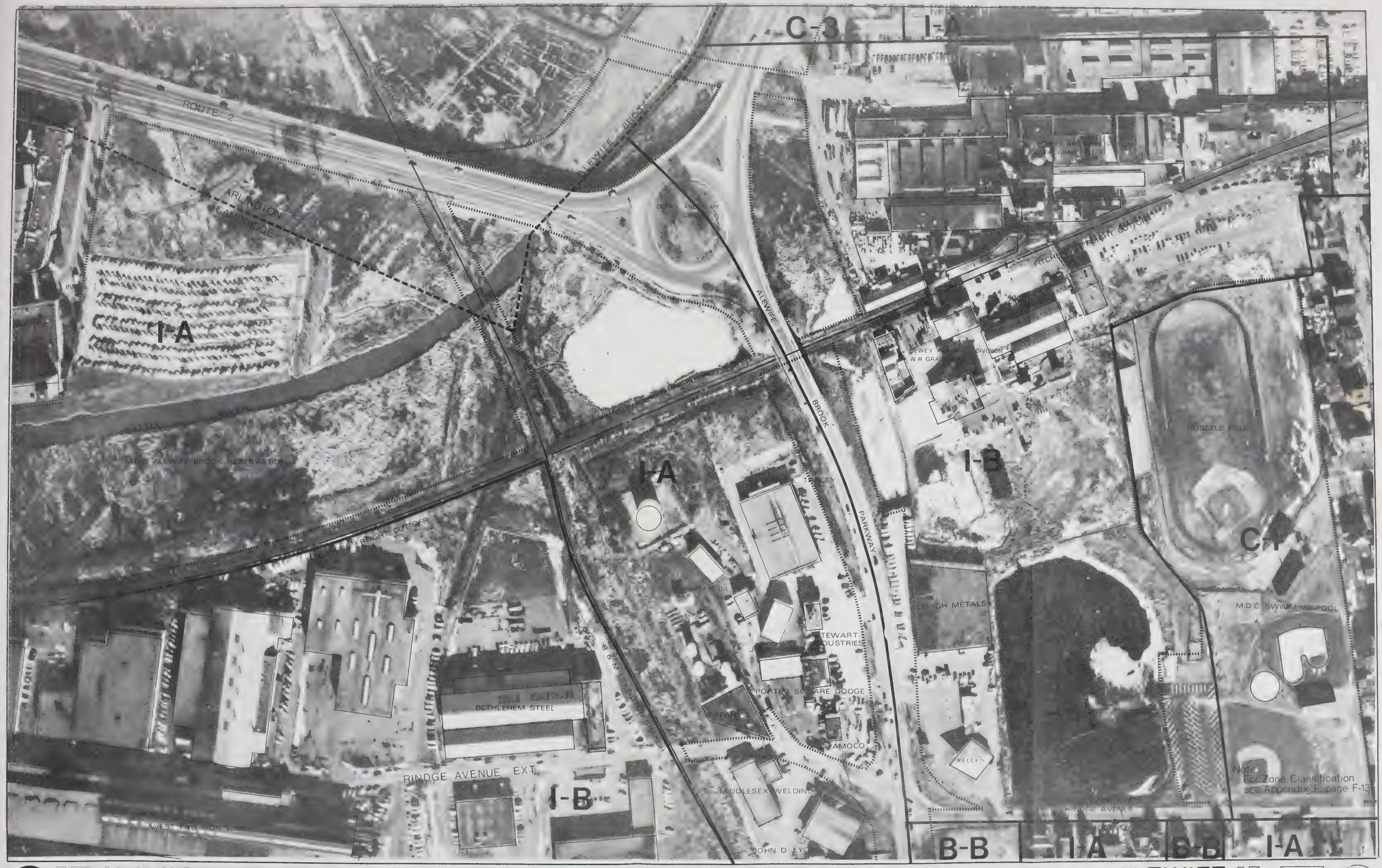
It is estimated that there will be 189,000 cubic yards of excavated materials in this segment.

Ecological and Hydrologic

For a discussion of the ecological impacts of station and tunnel/ cut-and-cover construction turn to Page VI-105.

Parks, Recreation and Historic Resources

Two public open spaces are located within this segment: Russell Field and Alewife Brook Reservation. For a discussion of impacts, turn to the Section 4(f) Statement on page II-127.



Massachusetts Bay Transportation Authority

ALEWIFE
EXISTING CONDITIONS

FIG. VI-1

RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority
De Leuw, Cather & Company / Sverdrup & Parcel and Associates Inc.

ALEWIFE
LOCATION PLAN
FIG. VI - 2

Yates Pond

Fitchburg Freight Cut Off

Up

Up

Down

Down

Short-Term Parking
60 Spaces

Skylight
Open to Mezzanine Below

Pedestrian Underpass

W.R. Grace

Pick-Up / Drop-Off Platform

Bus Platform

Alewife Brook Parkway

East Entry

Bethlehem Steel

Retention Area

Rindge Avenue Extension

Up

Down

Limit of Potential Joint Development

Lehigh Metals

Relocated Bedford Branch

Jerry's Pond

0 20 40 120

north

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
RED LINE EXTENSION NORTH WEST
CONTRACT NO 065-006
ALEWIFE STATION/GARAGE
Ground Floor Plan

WALLACE FLOYD, ELLENZWEIG MOORE INC Architects/Planners
SVERDRUP & PARCEL AND ASSOCIATES INC Structural, Civil, Mechanical & Electrical Engineers
LE MESSURIER ASSOCIATES SCI Structural Engineers

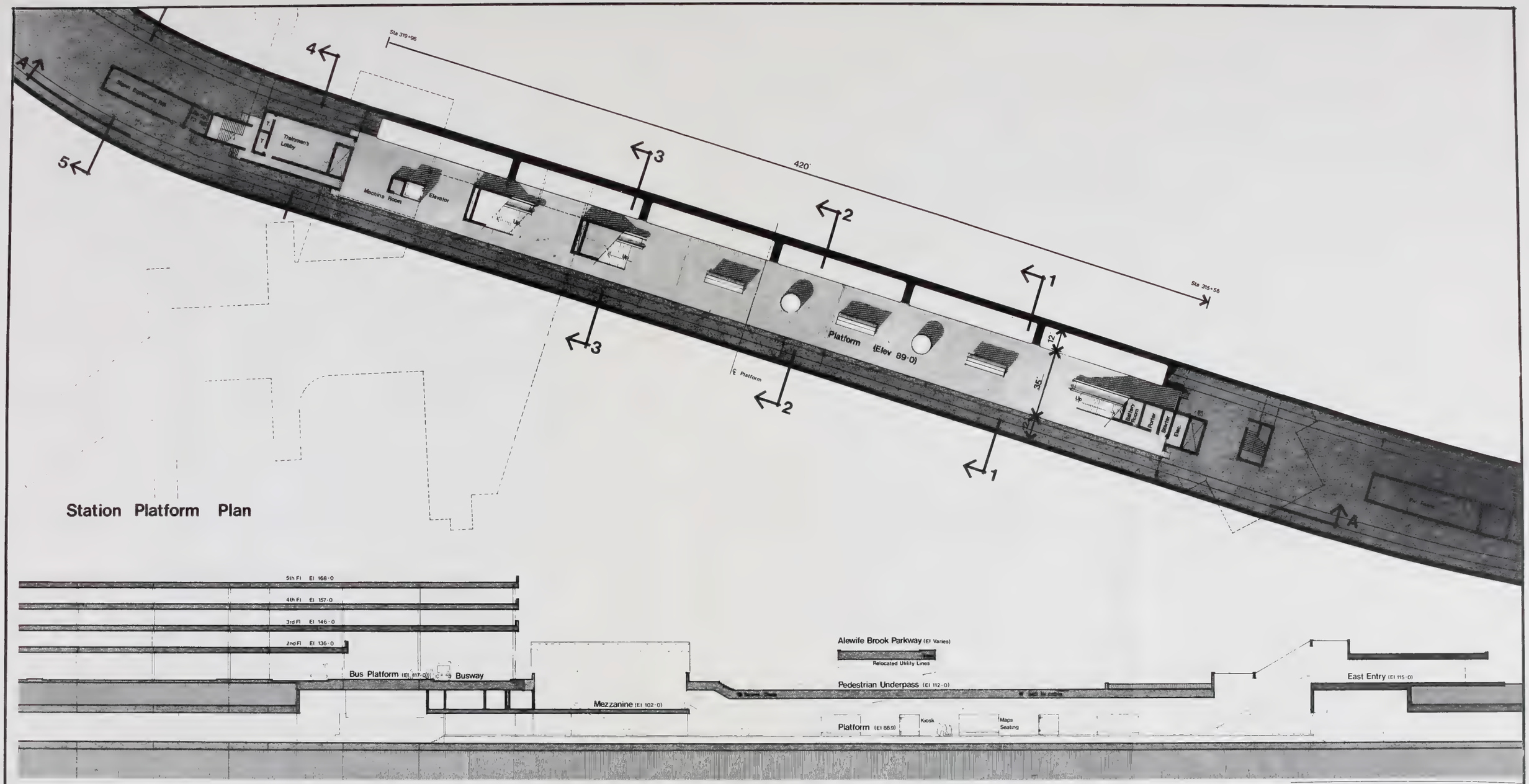
MASS BAY TRANSPORTATION AUTHORITY APPROVED BY
PROJECT MANAGER

NO	DATE	DESCRIPTION	BY	CHKD APP

SCALE 1" 40 | DRAWN BY | DESIGN BY | CHECK BY | PLAN NO A-065-38
DATE 1-78 | SHEET 7 OF 30

RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

ALEWIFE
GROUND FLOOR PLAN
FIG VI - 3



Station Platform Plan

Section A·A

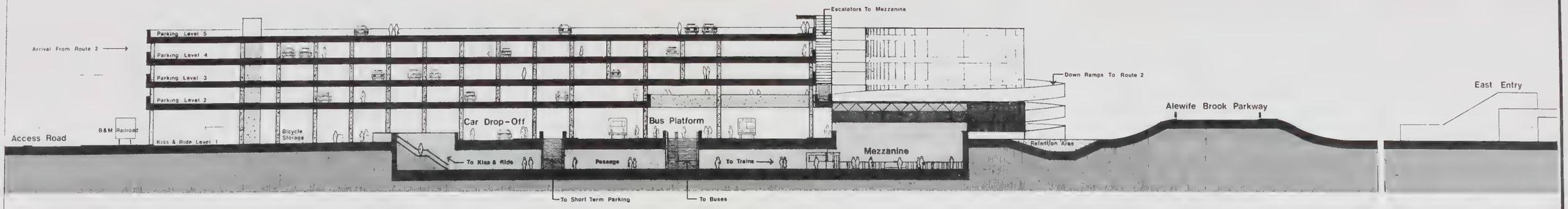
ISSUE	DATE	DESCRIPTION	BY	CHKD

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
RED LINE EXTENSION NORTH WEST
CONTRACT NO. 065-006
ALEWIFE STATION/GARAGE
Station Platform Plan

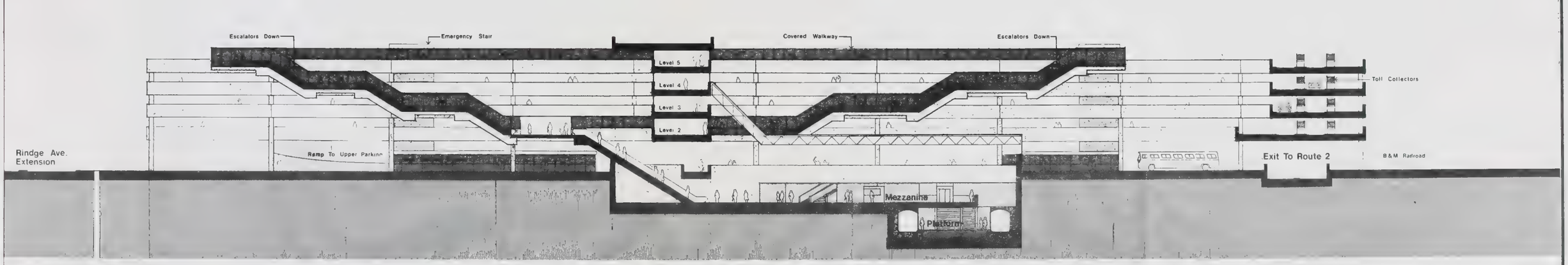
WALLACE FLOYD ELLENZWEIG MOORE, INC
Architects/Planners
SVERDRUP & PARCEL AND ASSOCIATES INC
Structural Civil Mechanical & Electrical Engineers
LE MESSURIER ASSOCIATES / SCI
Structural Engineers

MASS BAY TRANSPORTATION AUTHORITY
APPROVED BY
PROJECT MANAGER

SCALE 1'-20	DRAWN BY	DESIGN BY	CHECK BY	PLAN NO A-6K-41	ISSUE
DATE 3-29-77				SHEET 10 OF 30	



East – West Section



North – South Section

0 10 20 40 60

ISSUE	DATE	DESCRIPTION	BY	CHK'D APP'D

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

RED LINE EXTENSION NORTH WEST
CONTRACT NO. 065-006

ALEWIFE STATION/GARAGE

Garage Section

WALLACE FLOYD ELLENZWEIG MOORE, INC
Architects/Planners
SVERDRUP & PARCEL AND ASSOCIATES INC
Structural Civil, Mechanical & Electrical Engineers
LE MESSURIER ASSOCIATES / SCI
Structural Engineers

MASS BAY TRANSPORTATION AUTHORITY APPROVED BY

PROJECT MANAGER

SCALE 1" = 20'	DRAWN BY	DESIGN BY	CHECK BY	PLAN NO A-65K-47
DATE 3-[illegible]				SHEET 16 OF 30

RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

ALEWIFE
GARAGE SECTION
FIG. VI – 5

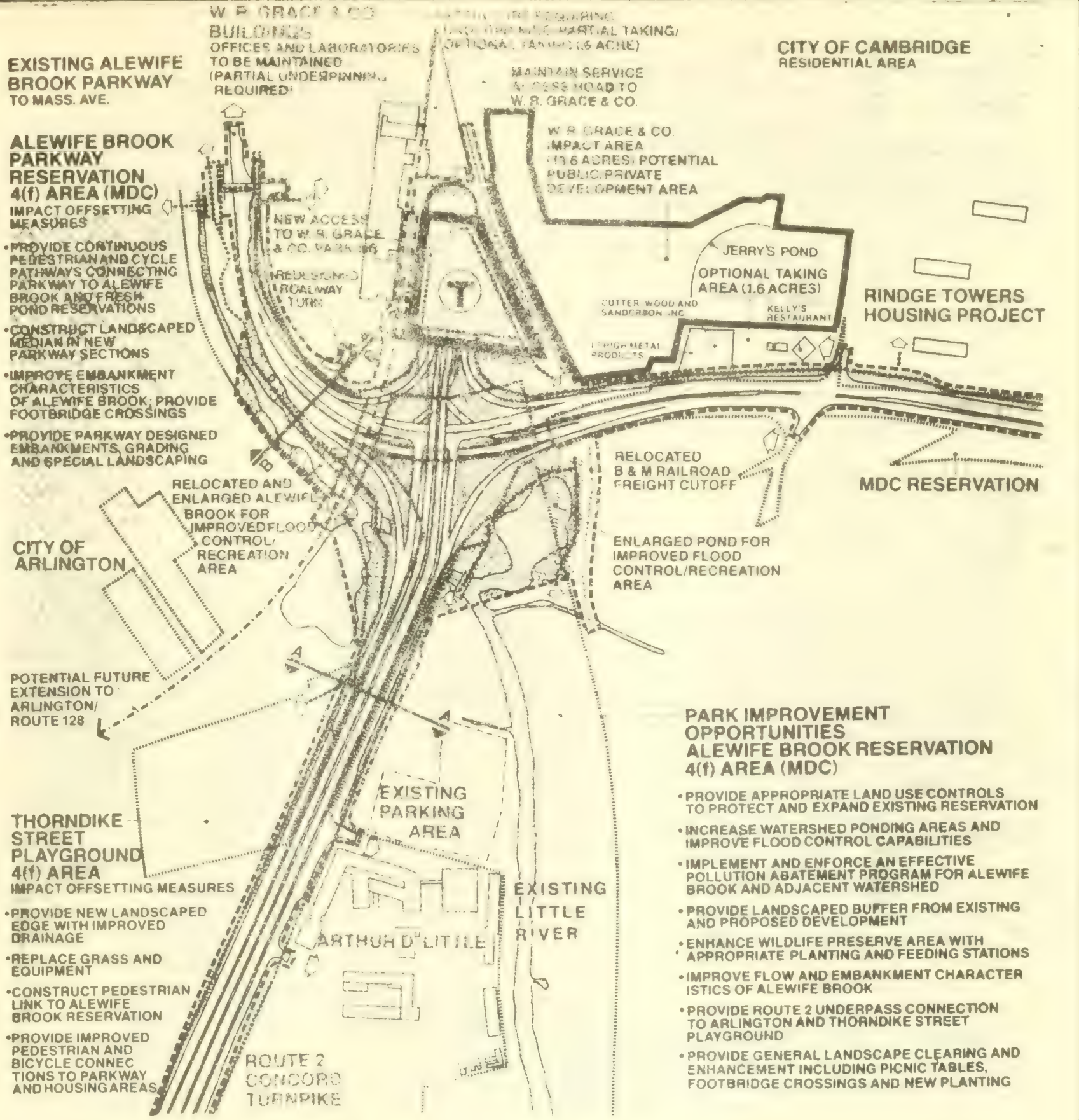
PRELIMINARY COMPARISON

ALTERNATIVE STATION LOCATIONS — ALEWIFE AREA

		STATION LOCATION A	STATION LOCATION B	STATION LOCATION C
MAN-MADE ENVIRONMENT — NATURAL ENVIRONMENT	CONSERVATION AND PRESERVATION AREAS	No takings for station facilities, limited takings (approximately 1-2 acres) for continuation of Red Line along B&M Bedford Branch.	No takings for station facilities; limited takings (approximately 1.5-2.0 acres) for continuation of Red Line along Bedford Branch; station location closest to critical MDC lands	No takings for station facilities; encroachment of station Area [illegible] Heights; potential impact on MDC lands and wetlands owned by Arlington along adjacent B&M ROW during construction phase.
	RECREATION	If Garden Street alignment selected, potential impact on recreation facilities proposed for Cambridge City Dump Site	Possible land takings at Russell Field (approximately 1-2 acres); potential impact on Thorndike Playground during construction phase.	Potential impact on [illegible] Park Playground during construction phase.
	FLOOD PLAIN	Extensive Encroachment	Minimal encroachment	No encroachment
MAN-MADE ENVIRONMENT	RESIDENTIAL DISPLACEMENTS	None	None	None
	COMPATIBILITY WITH SURROUNDING LAND USES	Highly compatible; adjacent to light manufacturing, Alewife Brook Parkway, and B&M Fitchburg Line	Moderately compatible, adjacent to light manufacturing, Alewife Brook Parkway, and MDC Reservation.	Slightly compatible; adjacent to chemical processing operation, and light manufacturing, relatively close to residential uses
	HISTORIC SITES/ BUILDINGS	No historical resources are affected.	Same as A	Same as A
	INDUCED LAND USES	Possible redevelopment of triangle.	Possible redevelopment of triangle, additional development pressures on vacant W. R. Grace properties	Redevelopment pressures on North Cambridge neighborhoods for higher density residential uses.
	URBAN DESIGN	Visually significant to Rindge Tower residents, location partially isolated by Alewife Brook Parkway bridge embankments and B&M railroad yards, lowest elevation of three sites. Alewife Brook Parkway bridge truss dominates area	Little visual impact to surrounding residential neighborhoods, most residents all, isolated site, most central to Alewife area, highly visible to auto traffic on Route 2 and Alewife Brook Parkway, no competing or conflicting structures.	Station could become terminus to Route 2, visually significant to East Arlington and North Cambridge residents competing and conflicting structures.
ECONOMIC	DEVELOPMENT COSTS	Not available at this time	Same as A	Same as A
	DISPLACED PROPERTY (Based on City of Cambridge Assessment and Tax Records)	$164,800 excluding J. D. Lyon Property	$[illegible]	$480,000
	LAND TAKINGS	Approximately 8-9 acres	Approximately 8-9 acres	Approximately 8-9 acres
	BUSINESS/EMPLOYMENT DISPLACEMENT	5 businesses/70-80 employees	11 businesses, 190-210 employees	Part of W. R. Grace/ 100-120 employees
	TAXES LOST, AS A RESULT OF DISPLACEMENT (1974 TAX REVENUES)	$19,923.81 (excluding J. D. Lyon Property)	$33,860.67	$[illegible] 18
COMMUNITY	NEIGHBORHOOD IDENTITY	No segmentation or isolation of neighborhoods.	Same as A	Same as A
	ACCESSIBILITY (TO CENTER OF SITE)	1600-2100 residents within ¼ mile walking distance	1500-2000 residents within ¼ mile walking distance	1900-2500 residents within ¼ mile walking distance
	NEIGHBORHOOD QUALITY	Potential noise and air pollution impact on Rindge Towers residents	Little direct impact on local neighborhoods.	Potential noise and air pollution impact on North Cambridge and East Arlington neighborhoods
CIRCULATION	PEDESTRIAN	Pedestrian/auto conflicts along Alewife Brook Parkway, least accessible to East Arlington and West Cambridge neighborhoods.	Pedestrian/auto conflict along Alewife Brook Parkway; reasonably accessible to East Arlington (via B&M Reservation Branch ROW under Route 2) and North Cambridge (via B&M freight cut-off under Alewife Brook Parkway).	Highly accessible to East Arlington and North and West Cambridge neighborhoods (requires at grade conflict at Alewife Brook Parkway for East Arlington users.
	AUTOMOBILE	Least accessible to Route 2 traffic, limited entry points from Alewife Brook Parkway most induced traffic on Alewife Brook Parkway.	Most accessible from Route 2	Requires redesign of Rewe, and Almy Circle; greatest potential for increased traffic and parking on local streets.
	FEEDER BUS	No potential conflicts, impacts	Same as A	Same as A
	COMMUTER RAIL	East transfer	Transfer possible, but preferred location for transfer capability is Porter Square	Same as A
	PARKING	Potential spillover onto Rindge Avenue and Fresh Pond Shopping Center parking lot	Potential spillover onto East Arlington neighborhood streets, possible need for resident sticker program.	Likely spillover onto North Cambridge neighborhood streets, need for resident sticker program.
DESIGN	GEOMETRICS	Not feasible with Davis Square alignment.	Feasible with all three proposed alignments	Only feasible with Davis Square alignment
	UNDERPINNING	None	None	Potentially, W. R. Grace Buildings and East Arlington residences
	CUT AND COVER CONSTRUCTION	Temporary re-channelling of Alewife Brook during cut and cover construction.	Same as A	Same as A

RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

ALEWIFE
ALTERNATIVES
IMPACT MATRIX
FIG VI - 6


W. R. GRACE & CO. BUILDINGS
OFFICES AND LABORATORIES TO BE MAINTAINED (PARTIAL UNDERPINNING REQUIRED)
EXISTING ALEWIFE BROOK PARKWAY TO MASS. AVE.
ALEWIFE BROOK PARKWAY RESERVATION 4(f) AREA (MDC)
IMPACT OFFSETTING MEASURES
•PROVIDE CONTINUOUS PEDESTRIAN AND CYCLE PATHWAYS CONNECTING PARKWAY TO ALEWIFE BROOK AND FRESH POND RESERVATIONS
•CONSTRUCT LANDSCAPED MEDIAN IN NEW PARKWAY SECTIONS
•IMPROVE EMBANKMENT CHARACTERISTICS OF ALEWIFE BROOK; PROVIDE FOOTBRIDGE CROSSINGS
•PROVIDE PARKWAY DESIGNED EMBANKMENTS, GRADING AND SPECIAL LANDSCAPING
MAINTAIN SERVICE ACCESS ROAD TO W. R. GRACE & CO.
CITY OF CAMBRIDGE
RESIDENTIAL AREA
W. R. GRACE & CO. IMPACT AREA (13.6 ACRES) POTENTIAL PUBLIC/PRIVATE DEVELOPMENT AREA
NEW ACCESS TO W. R. GRACE & CO. PARKING
REDESIGNED ROADWAY TURN
JERRY'S POND
OPTIONAL TAKING AREA (1.6 ACRES)
CUTTER WOOD AND SANDERSON, INC.
KELLY'S RESTAURANT
LEHIGH METAL PRODUCTS
RINDGE TOWERS HOUSING PROJECT
RELOCATED B & M RAILROAD FREIGHT CUTOFF
MDC RESERVATION
RELOCATED AND ENLARGED ALEWIFE BROOK FOR IMPROVED FLOOD CONTROL/ RECREATION AREA
CITY OF ARLINGTON
ENLARGED POND FOR IMPROVED FLOOD CONTROL/RECREATION AREA
POTENTIAL FUTURE EXTENSION TO ARLINGTON/ ROUTE 128
EXISTING PARKING AREA
THORNDIKE STREET PLAYGROUND 4(f) AREA
IMPACT OFFSETTING MEASURES
•PROVIDE NEW LANDSCAPED EDGE WITH IMPROVED DRAINAGE
•REPLACE GRASS AND EQUIPMENT
•CONSTRUCT PEDESTRIAN LINK TO ALEWIFE BROOK RESERVATION
•PROVIDE IMPROVED PEDESTRIAN AND BICYCLE CONNECTIONS TO PARKWAY AND HOUSING AREAS
EXISTING LITTLE RIVER
ARTHUR D. LITTLE
ROUTE 2 CONCORD TURNPIKE
PARK IMPROVEMENT OPPORTUNITIES ALEWIFE BROOK RESERVATION 4(f) AREA (MDC)
•PROVIDE APPROPRIATE LAND USE CONTROLS TO PROTECT AND EXPAND EXISTING RESERVATION
•INCREASE WATERSHED PONDING AREAS AND IMPROVE FLOOD CONTROL CAPABILITIES
•IMPLEMENT AND ENFORCE AN EFFECTIVE POLLUTION ABATEMENT PROGRAM FOR ALEWIFE BROOK AND ADJACENT WATERSHED
•PROVIDE LANDSCAPED BUFFER FROM EXISTING AND PROPOSED DEVELOPMENT
•ENHANCE WILDLIFE PRESERVE AREA WITH APPROPRIATE PLANTING AND FEEDING STATIONS
•IMPROVE FLOW AND EMBANKMENT CHARACTERISTICS OF ALEWIFE BROOK
•PROVIDE ROUTE 2 UNDERPASS CONNECTION TO ARLINGTON AND THORNDIKE STREET PLAYGROUND
•PROVIDE GENERAL LANDSCAPE CLEARING AND ENHANCEMENT INCLUDING PICNIC TABLES, FOOTBRIDGE CROSSINGS AND NEW PLANTING

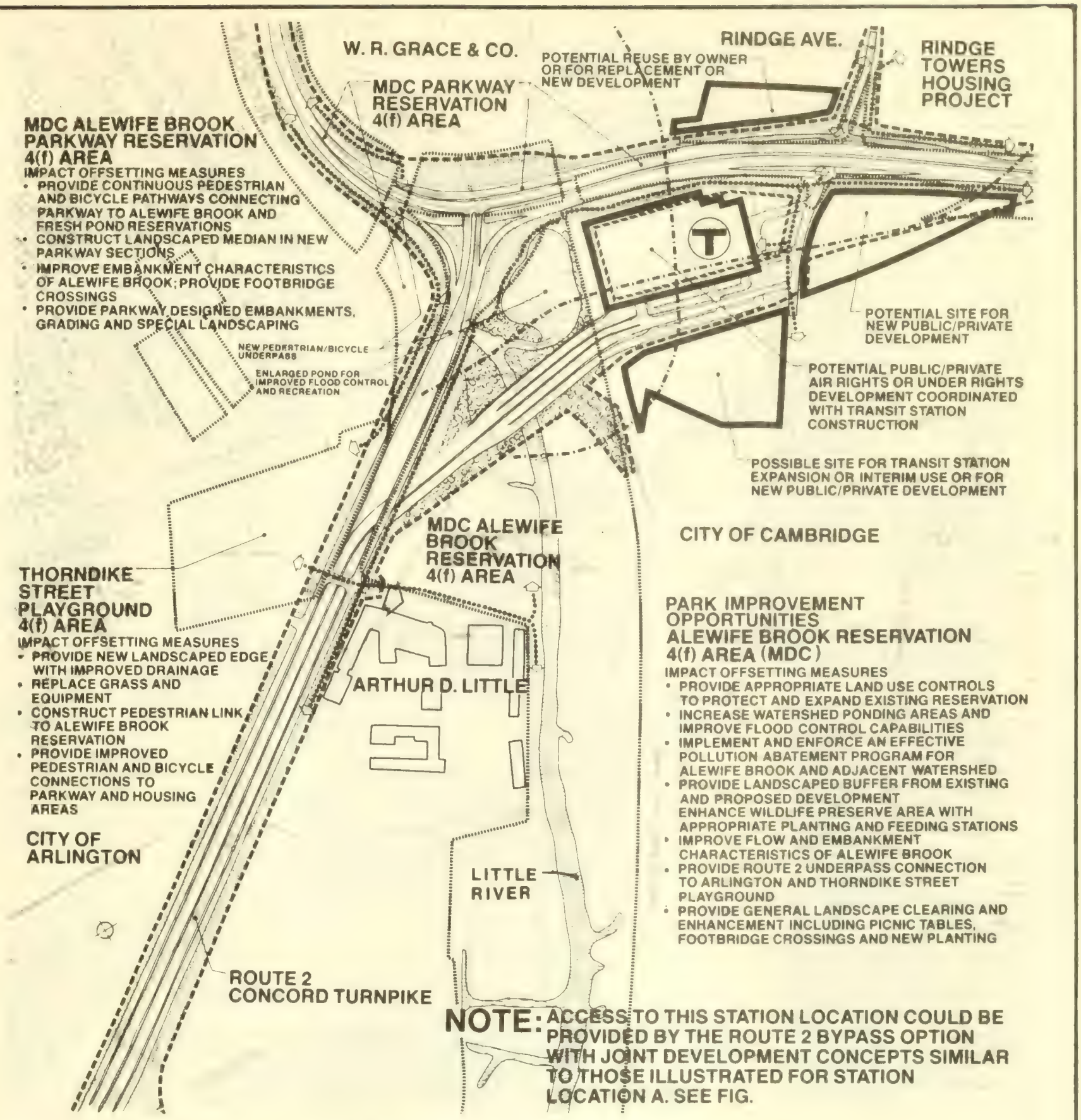
STATION LOCATION C

- STATION
- POTENTIAL PUBLIC/PRIVATE DEVELOPMENT
- POTENTIAL AIR-RIGHTS OVER-/UNDER-RIGHTS DEVELOPMENT
- REMEDIAL OPEN SPACE LANDSCAPING
- SPECIAL PARKWAY LANDSCAPING AND PLANTING
- WATER
- CENTERLINE OF MBTA RAPID TRANSIT TRACKS
- EXTENT OF PROJECT ACTIVITY
- 4(f) AREA BOUNDARIES
- PROPOSED BICYCLE/PEDESTRIAN PATH
- IMPROVED ACCESS TO EXISTING OR PROPOSED DEVELOPMENT

0 200 400 FEET

RED LINE EXTENSION
Massachusetts Bay Transportation Authority

ALEWIFE
JOINT DEVELOPMENT CONCEPTS
FIG. VI – 7


W. R. GRACE & CO.
RINDGE AVE.
POTENTIAL REUSE BY OWNER OR FOR REPLACEMENT OR NEW DEVELOPMENT
RINDGE TOWERS HOUSING PROJECT
MDC PARKWAY RESERVATION 4(f) AREA
MDC ALEWIFE BROOK PARKWAY RESERVATION 4(f) AREA
IMPACT OFFSETTING MEASURES
• PROVIDE CONTINUOUS PEDESTRIAN AND BICYCLE PATHWAYS CONNECTING PARKWAY TO ALEWIFE BROOK AND FRESH POND RESERVATIONS
• CONSTRUCT LANDSCAPED MEDIAN IN NEW PARKWAY SECTIONS
• IMPROVE EMBANKMENT CHARACTERISTICS OF ALEWIFE BROOK; PROVIDE FOOTBRIDGE CROSSINGS
• PROVIDE PARKWAY DESIGNED EMBANKMENTS, GRADING AND SPECIAL LANDSCAPING
NEW PEDESTRIAN/BICYCLE UNDERPASS
ENLARGED POND FOR IMPROVED FLOOD CONTROL AND RECREATION
POTENTIAL SITE FOR NEW PUBLIC/PRIVATE DEVELOPMENT
POTENTIAL PUBLIC/PRIVATE AIR RIGHTS OR UNDER RIGHTS DEVELOPMENT COORDINATED WITH TRANSIT STATION CONSTRUCTION
POSSIBLE SITE FOR TRANSIT STATION EXPANSION OR INTERIM USE OR FOR NEW PUBLIC/PRIVATE DEVELOPMENT
CITY OF CAMBRIDGE
MDC ALEWIFE BROOK RESERVATION 4(f) AREA
THORNDIKE STREET PLAYGROUND 4(f) AREA
IMPACT OFFSETTING MEASURES
• PROVIDE NEW LANDSCAPED EDGE WITH IMPROVED DRAINAGE
• REPLACE GRASS AND EQUIPMENT
• CONSTRUCT PEDESTRIAN LINK TO ALEWIFE BROOK RESERVATION
• PROVIDE IMPROVED PEDESTRIAN AND BICYCLE CONNECTIONS TO PARKWAY AND HOUSING AREAS
ARTHUR D. LITTLE
CITY OF ARLINGTON
LITTLE RIVER
ROUTE 2 CONCORD TURNPIKE
PARK IMPROVEMENT OPPORTUNITIES
ALEWIFE BROOK RESERVATION 4(f) AREA (MDC)
IMPACT OFFSETTING MEASURES
• PROVIDE APPROPRIATE LAND USE CONTROLS TO PROTECT AND EXPAND EXISTING RESERVATION
• INCREASE WATERSHED PONDING AREAS AND IMPROVE FLOOD CONTROL CAPABILITIES
• IMPLEMENT AND ENFORCE AN EFFECTIVE POLLUTION ABATEMENT PROGRAM FOR ALEWIFE BROOK AND ADJACENT WATERSHED
• PROVIDE LANDSCAPED BUFFER FROM EXISTING AND PROPOSED DEVELOPMENT ENHANCE WILDLIFE PRESERVE AREA WITH APPROPRIATE PLANTING AND FEEDING STATIONS
• IMPROVE FLOW AND EMBANKMENT CHARACTERISTICS OF ALEWIFE BROOK
• PROVIDE ROUTE 2 UNDERPASS CONNECTION TO ARLINGTON AND THORNDIKE STREET PLAYGROUND
• PROVIDE GENERAL LANDSCAPE CLEARING AND ENHANCEMENT INCLUDING PICNIC TABLES, FOOTBRIDGE CROSSINGS AND NEW PLANTING
NOTE: ACCESS TO THIS STATION LOCATION COULD BE PROVIDED BY THE ROUTE 2 BYPASS OPTION WITH JOINT DEVELOPMENT CONCEPTS SIMILAR TO THOSE ILLUSTRATED FOR STATION LOCATION A. SEE FIG.

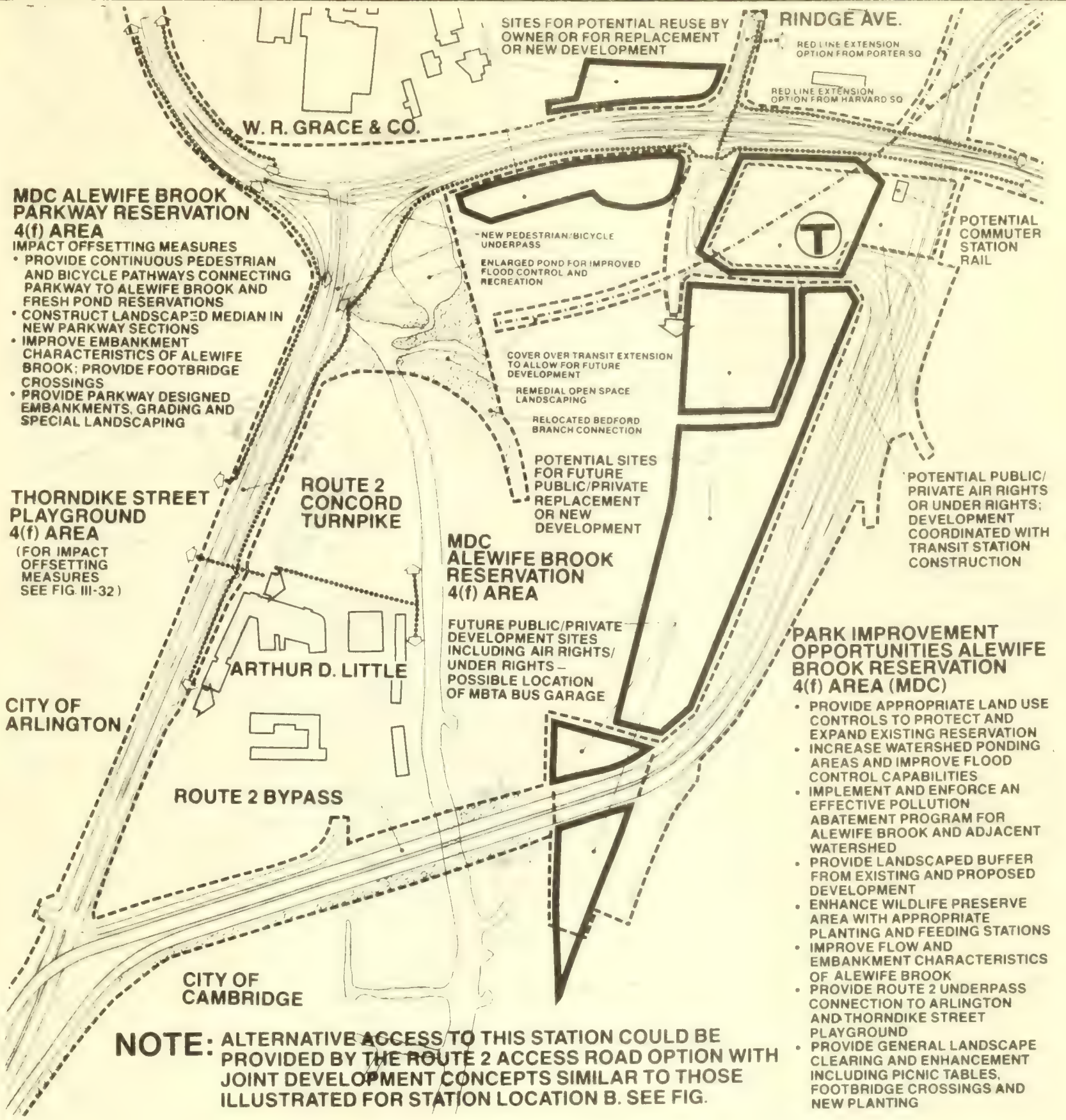
STATION LOCATION B

- STATION
- POTENTIAL PUBLIC/PRIVATE DEVELOPMENT
- POTENTIAL AIR-RIGHTS OR UNDER-RIGHTS DEVELOPMENT
- REMEDIAL OPEN SPACE LANDSCAPING
- SPECIAL PARKWAY LANDSCAPING AND PLANTING
- WATER
- CENTERLINE OF MBTA RAPID TRANSIT TRACKS
- EXTENT OF PROJECT ACTIVITY
- 4(f) AREA BOUNDARIES
- PROPOSED BICYCLE/PEDESTRIAN PATH
- IMPROVED ACCESS TO EXISTING OR PROPOSED DEVELOPMENT

0 200 400 FEET

RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

ALEWIFE
JOINT DEVELOPMENT CONCEPTS
FIG. VI - 8


SITES FOR POTENTIAL REUSE BY OWNER OR FOR REPLACEMENT OR NEW DEVELOPMENT
RINDGE AVE.
RED LINE EXTENSION OPTION FROM PORTER SQ
RED LINE EXTENSION OPTION FROM HARVARD SQ
W. R. GRACE & CO.
MDC ALEWIFE BROOK PARKWAY RESERVATION 4(f) AREA
IMPACT OFFSETTING MEASURES
• PROVIDE CONTINUOUS PEDESTRIAN AND BICYCLE PATHWAYS CONNECTING PARKWAY TO ALEWIFE BROOK AND FRESH POND RESERVATIONS
• CONSTRUCT LANDSCAPED MEDIAN IN NEW PARKWAY SECTIONS
• IMPROVE EMBANKMENT CHARACTERISTICS OF ALEWIFE BROOK; PROVIDE FOOTBRIDGE CROSSINGS
• PROVIDE PARKWAY DESIGNED EMBANKMENTS, GRADING AND SPECIAL LANDSCAPING
NEW PEDESTRIAN/BICYCLE UNDERPASS
ENLARGED POND FOR IMPROVED FLOOD CONTROL AND RECREATION
POTENTIAL COMMUTER STATION RAIL
COVER OVER TRANSIT EXTENSION TO ALLOW FOR FUTURE DEVELOPMENT
REMEDIAL OPEN SPACE LANDSCAPING
RELOCATED BEDFORD BRANCH CONNECTION
POTENTIAL SITES FOR FUTURE PUBLIC/PRIVATE REPLACEMENT OR NEW DEVELOPMENT
POTENTIAL PUBLIC/ PRIVATE AIR RIGHTS OR UNDER RIGHTS; DEVELOPMENT COORDINATED WITH TRANSIT STATION CONSTRUCTION
THORNDIKE STREET PLAYGROUND 4(f) AREA
(FOR IMPACT OFFSETTING MEASURES SEE FIG. III-32)
ROUTE 2 CONCORD TURNPIKE
MDC ALEWIFE BROOK RESERVATION 4(f) AREA
FUTURE PUBLIC/PRIVATE DEVELOPMENT SITES INCLUDING AIR RIGHTS/ UNDER RIGHTS – POSSIBLE LOCATION OF MBTA BUS GARAGE
ARTHUR D. LITTLE
CITY OF ARLINGTON
ROUTE 2 BYPASS
CITY OF CAMBRIDGE
PARK IMPROVEMENT OPPORTUNITIES ALEWIFE BROOK RESERVATION 4(f) AREA (MDC)
• PROVIDE APPROPRIATE LAND USE CONTROLS TO PROTECT AND EXPAND EXISTING RESERVATION
• INCREASE WATERSHED PONDING AREAS AND IMPROVE FLOOD CONTROL CAPABILITIES
• IMPLEMENT AND ENFORCE AN EFFECTIVE POLLUTION ABATEMENT PROGRAM FOR ALEWIFE BROOK AND ADJACENT WATERSHED
• PROVIDE LANDSCAPED BUFFER FROM EXISTING AND PROPOSED DEVELOPMENT
• ENHANCE WILDLIFE PRESERVE AREA WITH APPROPRIATE PLANTING AND FEEDING STATIONS
• IMPROVE FLOW AND EMBANKMENT CHARACTERISTICS OF ALEWIFE BROOK
• PROVIDE ROUTE 2 UNDERPASS CONNECTION TO ARLINGTON AND THORNDIKE STREET PLAYGROUND
• PROVIDE GENERAL LANDSCAPE CLEARING AND ENHANCEMENT INCLUDING PICNIC TABLES, FOOTBRIDGE CROSSINGS AND NEW PLANTING

NOTE: ALTERNATIVE ACCESS TO THIS STATION COULD BE PROVIDED BY THE ROUTE 2 ACCESS ROAD OPTION WITH JOINT DEVELOPMENT CONCEPTS SIMILAR TO THOSE ILLUSTRATED FOR STATION LOCATION B. SEE FIG.

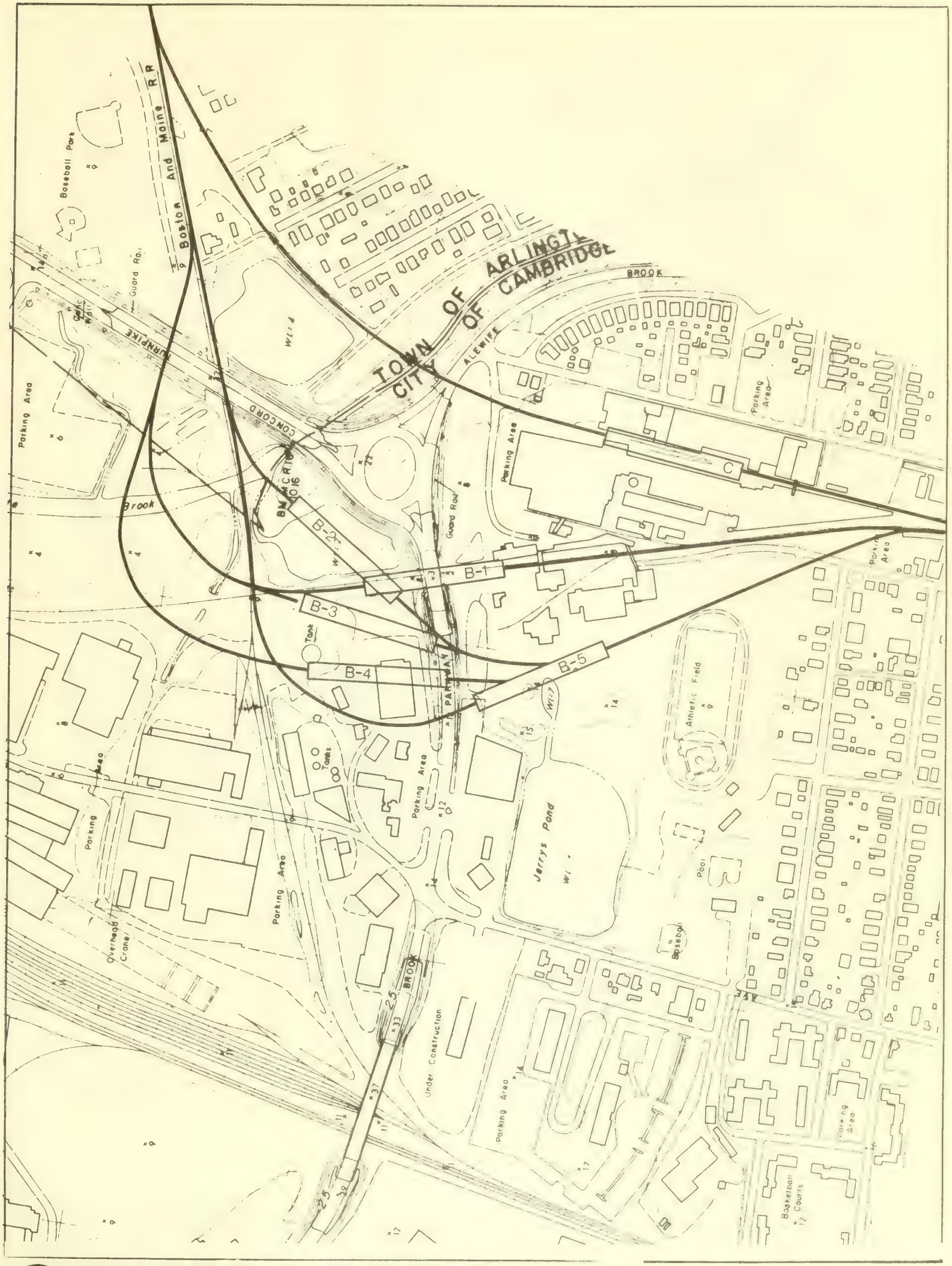
STATION LOCATION A

- STATION
- POTENTIAL PUBLIC/PRIVATE DEVELOPMENT
- POTENTIAL AIR-RIGHTS OR UNDER-RIGHTS DEVELOPMENT
- REMEDIAL OPEN SPACE LANDSCAPING
- SPECIAL PARKWAY LANDSCAPING AND PLANTING
- WATER
- CENTERLINE OF MBTA RAPID TRANSIT TRACKS
- EXTENT OF PROJECT ACTIVITY
- 4(f) AREA BOUNDARIES SEE ADJ.FIG.III-28
- PROPOSED BICYCLE/PEDESTRIAN PATH
- IMPROVED ACCESS TO EXISTING OR PROPOSED DEVELOPMENT

0 200 400 FEET

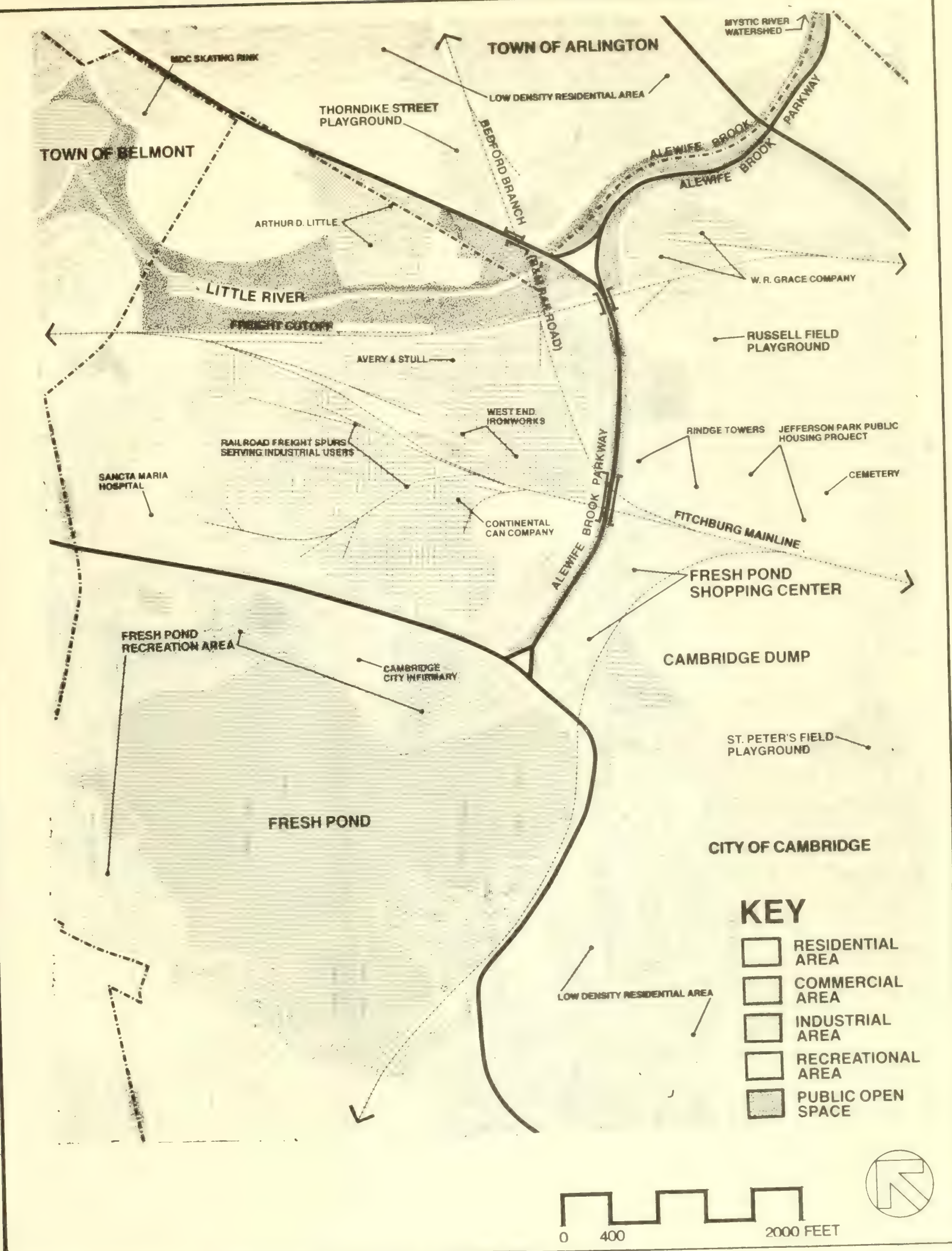
RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

ALEWIFE
JOINT DEVELOPMENT CONCEPTS
FIG. VI – 9



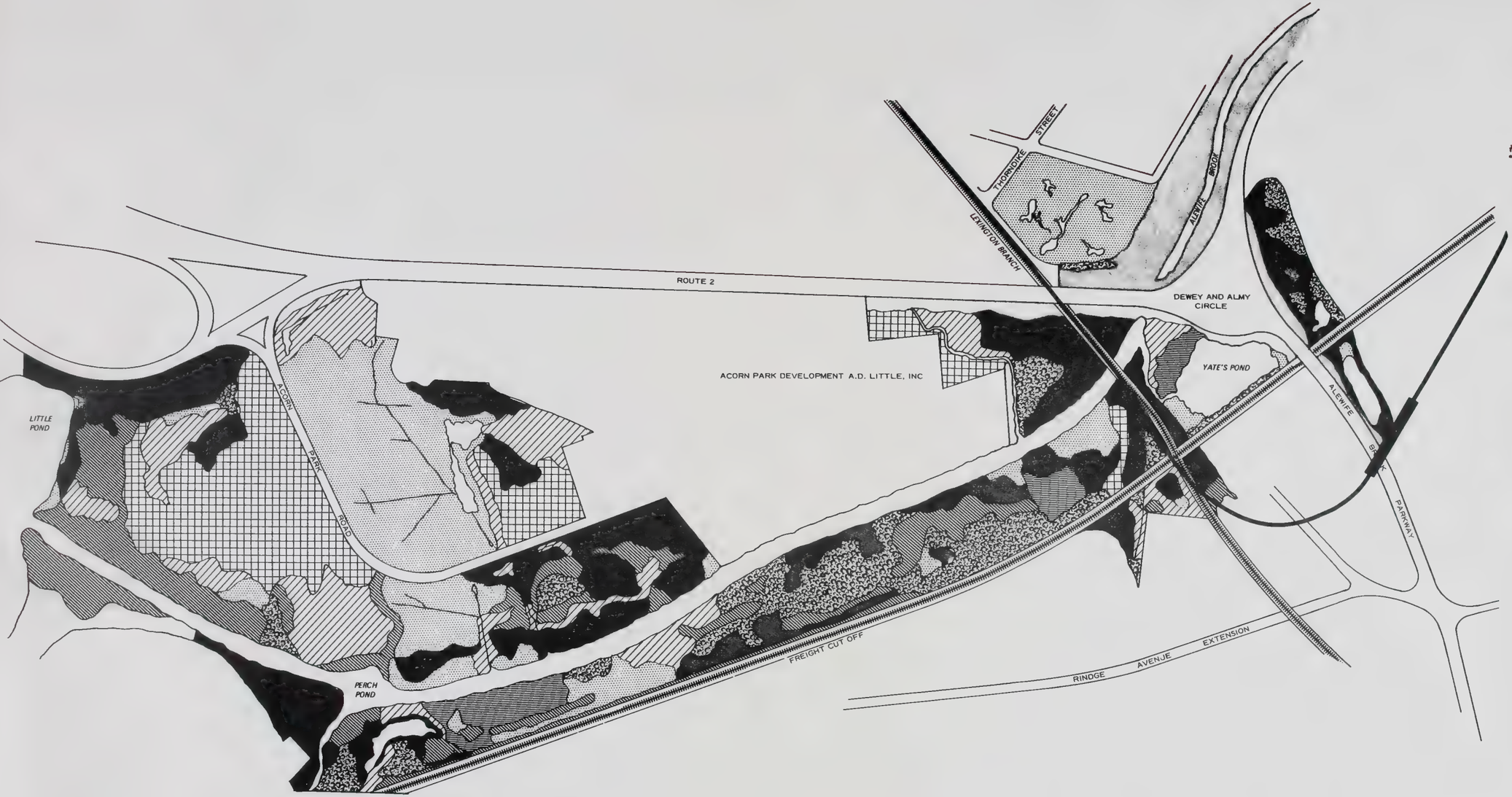
RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

ALEWIFE
"B" STATION ALTERNATIVES
FIG. VI – 10



RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

ALEWIFE
LAND USE AND PLANNING CONTEXT
FIG VI - 11



RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

ALEWIFE
WETLAND VEGETATIONAL CATEGORIES

FEET 0 50 200 400

FIG VI-12

RELOCATED 54" SIPHON

TEMPORARY CHANNEL

ALTERNATIVE PERMANENT LOCATION

54" CS

RELOCATED 66" S

R.O.W.

Railroad

R.O.W.

TEMPORARY CHANNEL

ALTERNATIVE PERMANENT LOCATION

TEMPORARY CHANNEL

ARLINGTON CAMBRIDGE

23'-3" x 15'-5" W 10' UNDERDRAIN

ROUTE 2

CONCORD TURNPIKE

R.O.W.

FITCHBURG BRANCH FREIGHT CUT-OFF

NEW LINE

24" R.C.P.

24" D.I.

FILL AREA

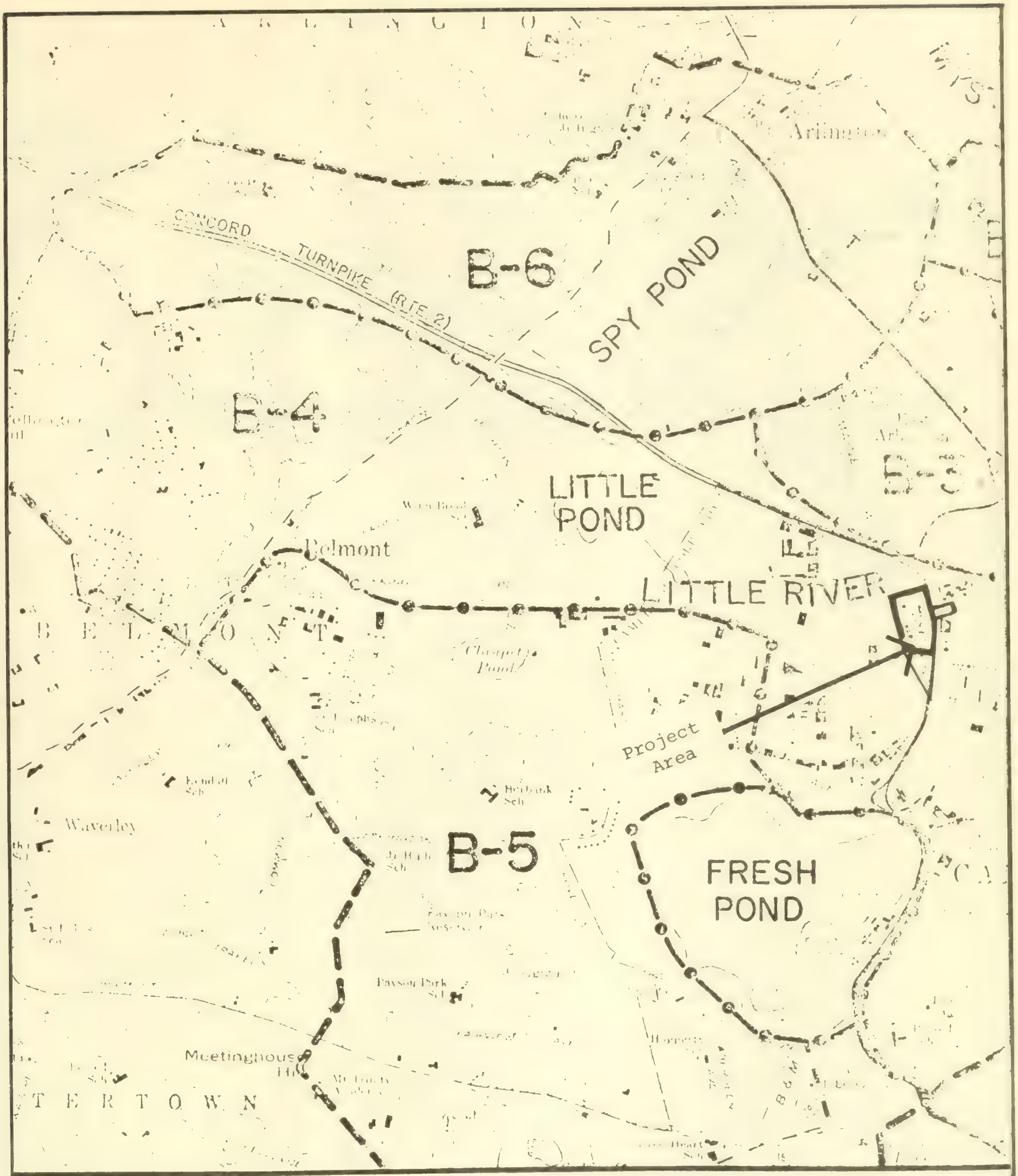
CAMBRIDGE ARLINGTON

BROOK

RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

ALEWIFE
TEMPORARY STREAM AND UTILITIES RELOCATIONS

FIG. VI-13

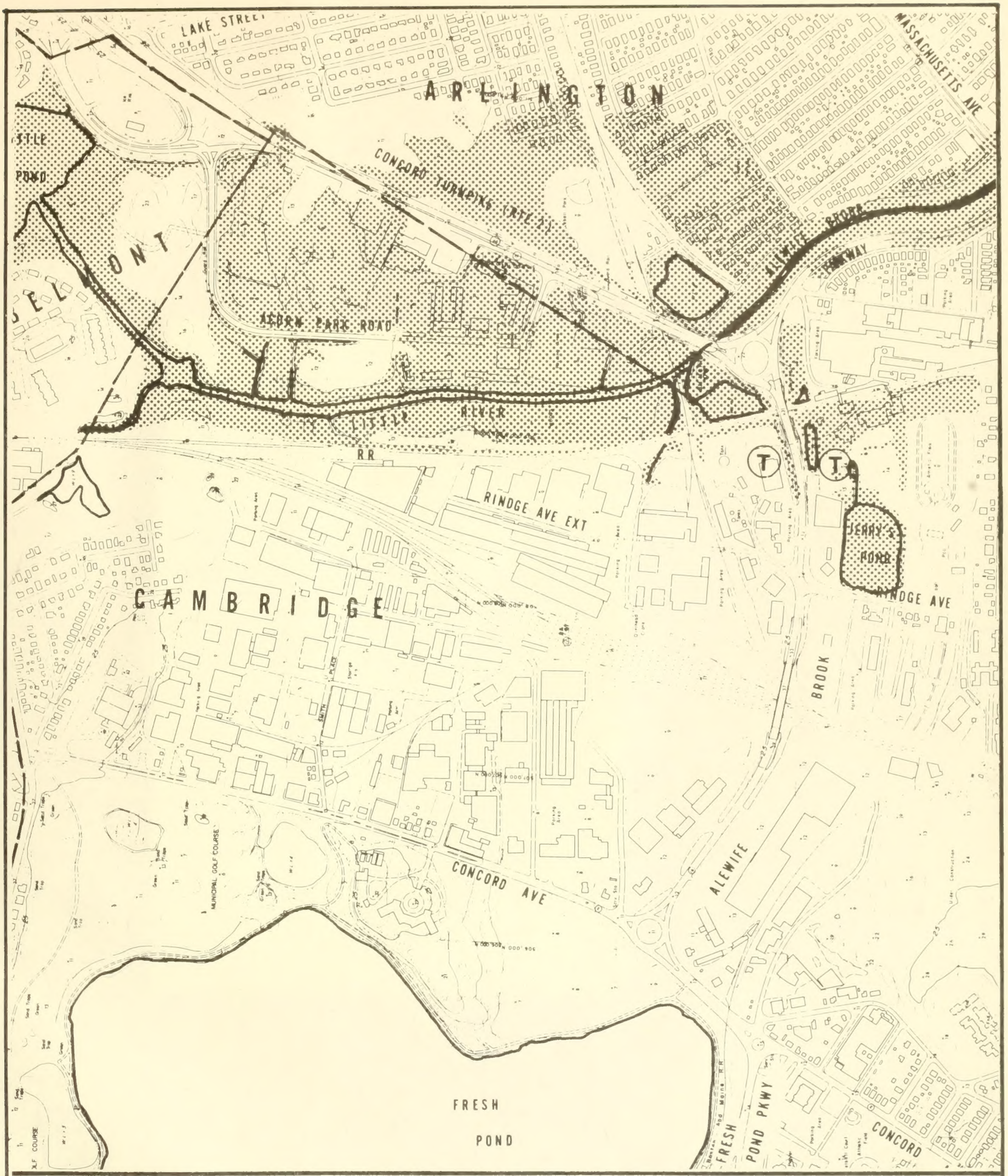


Alewife Brook Watershed Boundary

Source: Fay Spofford and Thorndike (ref. 2)

Massachusetts Bay Transportation Authority

ALEWIFE
ALEWIFE BROOK
WATERSHED BOUNDARY
FIG VI - 14



Natural Features

100 Year Floodplain Elevation 113.0 M.D.C. Base

Water Bodies

0 400 800 1200

RED LINE EXTENSION STUDY
Massachusetts Bay Transportation Authority

ALEWIFE
NATURAL FEATURES
FIG VI – 15

T23 U.S. Dept. of Trans.
U73 Urban Mass Trans. Adms.
V.1
Red Line Extension-Harvard
Square to Arlington Heights.

T23
U73
Vol.1